TEXAS REPORTS on BIOLOGY and MEDICINE

VOLUME 5, NUMBER 3 FALL, 1947

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RECENT DEVELOPMENTS IN THE PHYSIOLOGY OF MUSCLE, NERVE, AND BONE PERTAINING TO PHYSICAL MEDICINE AND REHABILITATION*

W. A. Selle

The increased interest in recent years in physical medicine has resulted in widespread investigations which are coming to fruition. Our knowledge of the physiological effects of the poorly understood and too infrequently used physical agents is now being materially advanced.

It is my purpose to indicate here some developments in our knowledge of the physiopathology of muscle, nerve and bone which directly or indirectly have a bearing on physical medicine. Most of the observations reported are those obtained from the literature during the past year.

I. Muscle

Incomplete denervation of muscles in laboratory animals is followed by "spontaneous" recovery not attributable to regeneration of the severed nerve fibers. This recovery was recently studied quantitatively by Weiss and Edds (1946) who followed the weight, strength and histologic changes in muscles and compared them with the residual nerve supply. According to the authors, all observed facts lead to the conclusion that the intra-muscular branches of the intact motor nerve fibers undergo additional branching and take over the supply of the denervated muscle fibers. This occurs only when intact and denervated elements lie intermingled; the stimulus for branching lies presumably in some traumatic contact action, and no "neurotropic" stimulation of branching or "attraction" of branches toward a solid denervated area has been noted.

The results suggest that similar compensatory branching with consequent improvement of muscle weight and strength might occur after diffuse poliomyelitic lesions, but not after

*Read before the Postgraduate Course in Physical Medicine, University of Kansas, Kansas City, January 13–18, 1947. From the Biophysics Laboratory of The University of Texas Medical Branch, Galveston.

partial traumatic injury. It remains to be seen whether these observations will be used by the proponents of neurotripsy in support of their highly-questioned technique.

Eisenhauer and Key (1945) have studied the optimum position of fixation of limbs in cats in order to conserve muscle power, and report that disuse atrophy is more marked in stretched muscles than in those maintained in the relaxed or neutral position. In denervation studies they found that atrophy is less if the operated muscles are left untreated than if immobilized by casts.

II. Electrical Stimulation and Massage of Denervated Muscle

It seems to have been established during the last few years that the loss of weight and strength of experimentally denervated muscle can be effectively retarded by the use of electrical stimulation under appropriate conditions. These conditions are: (1) a current must be used which will produce maximal tension in the muscle within the limits of tolerance; (2) the muscle must be stimulated at frequent periods; (3) treatment must be started soon after denervation. According to Kosman, Osborne and Ivy (1946), the contradictory reports of earlier investigators are probably due to a failure to observe one or more of these precautions. Kosman and associates, using the bilaterally crushed sciatic nerve, observed that: (1) The loss of weight and tension for both right and left gastrocnemii is approximately equal; (2) Loss of tension occurs at a more rapid rate and to a greater extent than weight loss; conversely, tension returns more rapidly as the nerve regenerates; (3) Appropriate electrical stimulation of the gastrocnemius muscle results in a heavier and stronger muscle both during the period of denervation and recovery; (4) Appropriate electrical stimulation when started after reinnervation has occurred is without effect upon the subsequent course of recovery.

Fischer, and Ramsey (1946) also found that daily electrical treatment of denervated rabbit muscles is effective in retarding weight loss and deterioration of muscle protein. Treatment applied to a leg in flexed position, so that the muscle contracts

against high resistance during stimulation, is much more effective than treatment in an extended limb position, in which the muscle contracts freely against little or no resistance.

Suskind and associates (1946) also report that suitable electrical stimulation retards weight loss of denervated gastrocnemii in cats but exerts no effect on the contractible strength per unit mass of muscle. Massage causes only a slight retardation of the weight loss but proves to be effective in maintaining the strength of denervated muscle. The difference between the weight and the strength of massaged and nonmassaged muscles tend to be equalized when the treatments are extended into the periods of reinnervation and regeneration. The findings support the practice of treating paralyzed muscles with a combination of electrical stimulation and massage.

III. Muscle and Joint Injury

Sir Morton Smart (1946), Manipulative Surgeon to the King of England, has recently published in the Archives of Physical Medicine a lucid account of the pathologic processes of injured joints. Part of this I quote:

"Joints are composed of various complicated and delicate structures, each one of which has an important part to play during movements, and the various special movements for which a joint is designed are normally performed painlessly and with the least amount of friction. The type of case most amenable to treatment by manipulation is that in which the main pathologic cause is interference to joint movements by the presence of adhesions. It must be emphasized that in all joint movements the areolar tissue plays a more important part than is generally considered. This tissue forms a supporting bed between the muscles, blood vessels, nerves and all deep-seated structures and in so doing fills up the crevices and spaces around a joint and acts as padding and an investing sheath to many structures.

"In all joints it is essential to have free movement of one part over another, and, as the range of these movements varies in individual joints, the fibers of the areolar tissue are

specially arranged to accomplish this. In addition, the tissue contains a small quantity of translucent lymphlike fluid which keeps it moist and thus gives to it the necessary flexibility and suppleness to enable the joint to move with the minimum of friction. Trauma or disease may lead to the loss of function of a joint in varying degrees. The common results are stiffness, atony, and wasting of muscles and limitation of movement by adhesions, and all these results are the sequel to the changes in living vascular tissue reacting to some form of irritation ending in the formation of an inflammatory exudate. This exudate spreads into the tissue spaces in amounts varying according to the severity of the injury, and the distance to which it may penetrate depends on the looseness of the texture of the affected tissue. In comparatively loose tissue, such as muscle, considerable separation of the muscle fibers results, and when the exudate collects within the inextensible sheaths the pressure effects on the fibers cause tension and produce pain and loss of function.

"This interstitial pressure in joint structures interferes with nutrition and stretches the areolar tissue producing stiffness owing to loss of the flexibility and suppleness of the tissue. The penetration into the tissues of the fluid and solid constituents of the blood following injury acts on the various tissue elements pathologically by increased tissue growth and loss of flexibility of the areolar tissue and by the formation of adhesions if the exudate becomes organized into fibrous tissue; it acts mechanically by pressure on or stretching of the cellular elements and their supporting framework and by the binding effects of adhesions.

"As inflammation is a process leading to repair of damaged tissue, the beneficial effects can follow only if the processes of inflammation necessary for repair are carried to a successful issue, and those results depend on the completeness of absorption of the effusion into the tissues. If these processes are prolonged and particularly if the part is kept unduly at rest, the general effect on the muscles is that they lose their tonicity, irritability, elasticity and contractility followed by atrophy with loss of function to all degrees. In this condition the muscles become relaxed and their tendons are at an operating disadvantage mechanically so that effective pull on their points of attachment is diminished and seriously interferes with efficient joint movement. In addition joint structures such as ligaments and capsules become stretched and loose in their texture and so diminish their passive supporting qualities."

In an earlier article (1945) Sir Morton discussed the rationale of treatment of injured muscles and joints by faradic stimulation. He points out that when an injured limb is kept at rest its circulation is diminished and absorption is not sufficiently stimulated. He reminds us that an active muscle requires six times as much blood as does the same muscle at rest.

Another important point stressed is "that the upward flow of the venous blood from the lower extremities in the upright position is mainly due to the pumping action of the muscles." When there is exudation into the tissues following trauma, absorption is impaired and the tissues become stretched by the long-continued tension and so remain relaxed for a considerable period. Finally when organization does occur, the tendons and muscles tend to become matted together, and varying degrees of limitation of movement and pain result.

Sir Morton emphasizes that adhesions and muscular wasting can be reduced to a minimum if maximal physiologic activity of muscles is maintained during the process of tissue repair. This can be accomplished with certainty, he maintains, by proper graduated muscular contractions initiated as soon after injury as possible. This treatment has a sound physiologic basis and requires for efficient administration thorough knowledge of fundamental principles of muscle action. He stresses that while early treatment is of immense importance in all diseases and injuries, it is most true of adhesions and loss of muscle function.

Many joints which are functionally inefficient for a long time after even a minor injury owe their disability to simple mechanical disturbances caused by atonic and wasted muscles and periarticular adhesions. When such muscles are restored to full function by graduated contractions and adhesions are freed by manipulation, crippling symptoms rapidly disappear. Sir Morton states that treatment of muscles by electrical methods producing contractions that are exactly controlled in (1) degree of each contraction, (2) rate of contractions in a given time and (3) completeness of relaxation before the next contraction is not suggested as a substitute for voluntary activity which should be encouraged.

IV. Exercise

Interest in the types of exercise most useful in injuries has been reawakened by the work of DeLorme (1946) who classifies muscles according to power, speed, endurance and coördination. He expresses the opinion that exercises of low resistance, such as bicycle riding, lifting light sand bags, weights or pulleys, and given in a high number of repetitions, produces endurances; on the other hand, high resistance, low repetitive exercises, produce power. Fatigue, he contends, is not due so much to overcoming resistance, but to the sheer number of repetitions. DeLorme believes that while low resistance, low repetitive exercises are of no significance in increasing power or endurance, they are of value in increasing joint movement. He further believes that "weakened atrophied muscles should not be subjected to endurance-building exercises, until the power has been restored to normal by power-building exercises."

Disabilities from various orthopedic conditions frequently result, as we have seen, in limitation of motion at the joints and loss of muscle strength. Usually strength is rapidly developed by exercises with apparatus offering suitable resistance or by ordinary daily activities, but increase in range of motion does not respond to these procedures, according to Deaver (1946), who has recently described in detail special pulley exercises for almost any joint. Such exercises, designed to stretch the muscle with a minimum of muscle spasm resulting from pain, are completely under the patient's control and therefore diminish the chances of injury to the joint.

V. Electromyography

The chief diagnostic function of specialists in physical medicine is appraisal of excitability of nerve and muscle by stimulation with appropriate electrical current. Most physicians are cognizant of the test for the "reaction of degeneration." Physiatrists are familiar with the responses of muscles to stimulation by direct or galvanic currents. Some are experienced in chronaximetery. While chronaxic measurements are of greater quantitative value than are galvanic and faradic tests, they are subject to certain sources of error, since the type,

position, and size of the electrodes greatly influence the results.

A new and entirely different method of electrodiagnosis, known as electromyography, makes use of recordings of small electrical potentials from muscles at rest or during voluntary contraction. Since these potentials are of extremely low voltage and short duration, a highly sensitive amplifier and recording system, such as the cathode ray oscilloscope or amplifiers employed for recording brain potentials, must be employed. Bipolar electrodes are used, either percutaneously or by inserting a concentric needle into the muscle to be investigated. With these technics normal resting muscles give rise to no electrical discharges. During voluntary contraction, action potentials of a relatively high frequency and voltage and characteristic appearance are recorded. These action potentials are, of course, not obtained in paralyzed muscles with complete denervation. Partially denervated muscles, on the other hand, may discharge scattered diphasic spikes, indicating some motor-unit activity, although no visible contraction is observable. Accordingly, the appearance of these spikes quickly differentiates a complete from a partial lesion.

In the case of complete degeneration, no action potentials are recordable, but if a proper type of amplifier is used, such as a cathode ray oscillograph, minute spontaneous resting discharges of low voltage and duration may be recorded and identified as fibrillation of denervation, giving positive evidence of a complete lesion.

Even with this improved type of study, there is a necessary long period of waiting before the slow process of nerve regeneration can be detected peripherally in the muscle. Electromyography is, however, of considerable value in picking up the first signs of neurotization of muscle in the form of spontaneous discharges of high voltage, indicating beginning motor-unit activity. This method is gradually assuming increasing importance as a means of detecting and recording various degrees and phases of peripheral nerve disturbances and in prognosis. Claims are made that it can be used to detect the level and extent of lower motor neuron lesions,

as the amount of denervation in individual muscles is assessable. Electromyography is still in the developing stage; it requires expensive equipment and is therefore used only in special laboratories. In coming years it will certainly find more frequent clinical use.

VI. Muscle Spasm

Various explanations for the development of muscle spasm in poliomyelitis have been advanced during the past year or two. Some of these are original, others are modifications of previously advanced theories. Kabat and Knapp (1944) favor the "internuncial cell theory" of the mechanism of spasm. They present evidence to support the view that the pathologic basis of spasm is a lesion of the internuncial neurons of the cord gray matter. With damage to these cells, muscle spasm is produced as a result of the release of proprioceptive reflexes from inhibition. They further support these experimental observations by the study of pathologic changes in the spinal cord in 68 cases of human poliomyelitis, by measurement of chronaxia of muscles in 14 patients and by the use of neostigmine acting on the spinal cord to inhibit proprioceptive reflexes.

Bouman and Schwartz (1944), as well as others, demonstrated the existence of spasm by means of action currents. They consider that the motor neuron receives three separate groups of impulses: (1) impulses which give rise to voluntary contraction, (2) inhibitory impulses, and (3) excitary impulses from the reflex arcs. They postulate that if the excitability to inhibitory impulses alone is gone the motor unit innervated by the particular neuron will show spasticity but no decrease in voluntary function. If both the inhibitory and the voluntary impulses are no longer able to excite the motor neuron, spasticity will be present, while the muscles will show decreased function, and, finally, when all motor neurons have lost the excitability to all three types of impulses both voluntary contraction and spasticity of muscles will disappear.

Several years ago Watkins and associates (1943) reported that (1) during the acute stage only muscles with some degree of paralysis discharge electrical potentials at rest and

that these electrical abnormalities are not correlated with the presence of clinical spasm; (2) that partially paralyzed muscles are hyperirritable to passive stretching, as indicated by electrical discharges and pain, concluding that muscle tension thus developed appears to be a reflex protective mechanism; and (3) that there occurs simultaneous activation of protagonists and antagonists, representing a disordered reciprocal innervation, which may account for "incoördination," as the term is used in the Kenney concept.

Schwartz and colleagues (1944) also discuss the significance of muscle spasm in acute poliomyelitis and bring out the fact that evidence of spasticity has been recorded from (1) weakened muscles; (2) antagonists of weakened muscles, and (3) muscles which exhibit no clinical or other evidence of weakness. They feel that spasticity and weakening are two separate phenomena, each dependent on specific disturbances of the anterior horn cells. They further state that there is every indication that spasm runs its course like other clinical manifestations of the disease.

These findings indicate that we still do not have a clear explanation for the mechanism and significance of spasm.

VII. The Use of Curare and Neostigmine

A discussion of curare and neostigmine is included at this point because discovery of a safe drug affording relaxation of muscle spasm in certain conditions and permitting institution of physical therapy would be of great value. The use of curare in convulsive therapy is widely known. It has also proved useful in obtaining muscle relaxation during anaesthesia and tetany. Its use in muscle spasm and spasticity is now being tried.

Ransohoff (1945), and Fox (1945, 1946) have used it in poliomyelitis with varying results. Ransohoff reports marked reduction in pain, relief in muscle spasm, and earlier capacity for exercise following the use of the drug in aqueous solutions. The basic dose averaged 0.9 units per kilo of body weight. Fox has tried the drug in 34 cases. Although a few of the patients noted subjective improvement, the observations, objectively, were not encouraging. Bulbar cases did not respond

to the treatment, and in some cases a rapid downward course necessitated the use of artificial respirators. Fox points out that curare may in some instances be of temporary benefit, but it is a dangerous drug and is not to be encouraged for the treatment of the acute phase of poliomyelitis.

Curare has been given intramuscularly by Elkins and Wegner (1946) in spastic conditions following injuries of the spinal cord. Doses started at 1.0 mg. per kilo of body weight and increased gradually to almost 3.0 mg. per kilo. The results were not striking and the only conclusion to be reached is that the brief and moderate improvement in spasticity produced by the curare is hardly useful except as an adjunct to other therapy, such as splinting, traction and passive exercise.

Schlesinger (1946), however, has used a suspension of curare in peanut oil and white wax to produce effective relaxation from muscle spasm in a group of 11 patients with injuries of the spinal cord. Reduction of spasticity for periods up to 3 days is claimed and without the usual side effects of the drug, such as severe changes in accommodation and head drop. Slow absorption, with avoidance of unpleasant side effects is stated to enhance greatly the therapeutic value of the drug. Schlesinger reports that the effect of curare in oil on patients with some voluntary function masked by spasticity seemed even more dramatic than the effect seen in paraplegic patients. He believes that the effect of curare in oil in treatment of syndromes exhibiting spasticity, tremor or rigidity will prove valuable and should be further explored.

Numerous reports have appeared during the past few years on the value of neostigmine in relaxing muscle and increasing motor power. The fact that neostigmine and curare are, at least in part, pharmacological antagonists makes the recent literature on neostigmine of special interest. Since 1940 there have been successive reports on the use of this drug (or physostigmine and atropine) in a variety of conditions including muscle spasm, spasticity, contracture, muscular pain, weakness, incoördination and fatigue, chronic rheumatoid arthritis, fractures and other injuries, hemiplegia, spastic

cerebral palsy, subacromial bursitis, facial paralysis, stiff neck and low back pain. Methods have varied so that the reviewer finds it difficult to assess the value of the drug; in some instances it was used with other forms of therapy. Viets, (1945), has shown that neostigmine has an established place in the therapy of myasthenia gravis. In this disease there appears to be a defect in conduction at the myoneural junction which can be corrected by neostigmine. The fatigue and weakness of the disease are overcome by the drug apparently through action on cholinesterase at the myoneural junction, with resulting facilitation of the passage of excitation to the skeletal muscle.

The description of a beneficial effect of neostigmine as a depressant of neuromuscular activity at first appears paradoxical to one familiar with the conventional pharmacological concepts of neostigmine effects. Kabat, and his associates, (1946), however, have prefaced their clinical presentations with an interesting hypothesis as to its mode of action. They state that the inhibitory action of this drug on the motor system may occur in two ways: (1) It acts at the myoneural junction in small doses as a stimulating agent, the effect usually thought of, but in larger doses it acts to inhibit transmission at the myoneural junction, (2) By action directly on the spinal cord, neostigmine depresses deep reflexes and muscle tonus both in animals and in man.

The first therapeutic application of the inhibitory action of neostigmine on the neuromuscular system was reported by Kabat and Knapp in 1944. These workers claimed that the drug decreases muscle spasm (hypertonus and proprioceptive reflex hyperirritability) and incoördination in poliomyelitis. They reported that the drug accelerates recovery in subacute and chronic cases, that its effects are not nullified by atropine and that the improvement is usually retained after therapy is discontinued. These observations were confirmed by Boines (1944).

Brainerd, Katz, Rowe and Geiger (1945) report that in 24 of 28 early cases a significant degree of muscle relaxation occurred within one hour; relaxation of spasm was sometimes

dramatic. (Children under 6 were given 0.5 mg.; those between 6 and 12, 1 mg., and adults 1.5 mg.)

Fox and Spankus (1945) also report on 24 polio patients who were put on neostigmine therapy about 5 days after onset of the disease. Average duration of therapy was 14.6 days. Although there were numerous drug reactions, they were not regarded as severe. Unlike the results of Brainerd and associates, there was no constant relaxation of muscle spasm. Some showed marked improvement; some showed increase in the spasm. However, the authors claim that the studies indicate neostigmine produces partial relaxation of the spastic muscles in most cases of acute poliomyelitis. The relaxation is neither dramatic nor constant; it is characterized by irregularity in response and is followed by a gradual return of spasm. The continued use of neostigmine and hot foments in treatments of acute poliomyelitis usually results in a perceptable and persistent relaxation of spastic muscles, which is evident after several days of therapy. The drug appears to be of little use in bulbar cases. Its further trial, however, is recommended by these workers.

Frankle and Cralle (1946) also conclude that neostigmine given with hot packs is of value in the early treatment of 58 cases of poliomyelitis, it being most effective when given intramuscularly. They claimed that the drug lessens incoordination and that early locomotion with or without braces gives the patient a better outlook and speeds rehabilitation. The end results so far as paralysis was concerned were no better than with previous methods of treatment but the patients did show less atrophy and less peripheral circulatory difficulty.

Neostigmine, as has been mentioned, is reported to have significant therapeutic value, as a result of relaxation of muscle spasm, in chronic rheumatoid arthritis, in fractures and other injuries, in hemiplegia, in spastic cerebral palsy, in subacromial bursitis and in cervical intramuscular fibrositis. In many of these conditions, in addition to relaxation of muscle spasm or contracture, rapid increase in strength, decrease in fatigue, improvement in coördination and relief from pain have been claimed.

Trommer and Cohen (1944) contend that 13 of 19 patients treated for rheumatoid arthritis had diminished muscular spasm, and motions were carried out more readily and with less pain. The effect following subcutaneous injection was said to be noticeable in fifteen minutes and persists for several days. Kuhns (1944), on the other hand, observed the effect of the drug in similar dosage on a large number of patients and reports that any beneficial effect observed was only slight and transient. No lasting benefit was observed. Experiments of Balboni, Hollander and Kydd (1946) on soldiers with rheumatoid arthritis at one of the Army's rheumatic centers led these workers to conclude that neostigmine induces no significant relaxation of muscle spasm in this condition. They state that the slight variations in range of articular motion can be accounted for by the daily variations caused by changes in weather, fatigue or other influences which so commonly make the rheumatic patient better on some days and worse on others. And so it goes, some find neostigmine valuable, others not.

VIII. Degenerative Joint Diseases

In a study of the innervation of articular tissues from patients having degenerative joint diseases, Freyberg found by staining with osmic acid three types of nerve endings: (1) free nerve endings, which may be on the surface of synovial cells; (2) an oval laminated end organ, usually deeper in the fibrous portion of the capsule, and (3) a fine network surrounding arterioles. No nerves were found in articular cartilage or in compact bone. All other articular structures were abundantly innervated. Pain fibers were distinct from those for touch and pressure. In patients there was a tremendous variation in the description of pain, although there was only a slight variation in the individual threshold for pain.

Goldberg (1944) has studied surgical and autopsy material to determine the early pathology of arthritis. The first changes in rheumatoid arthritis were in the synovial membrane and periarticular tissues, followed by changes in the articular cartilage and bone. The earliest changes were rarely seen in human

material but could be observed in experimental. The characteristic alterations in degenerative arthritis were in the articular cartilage. There was first a thickening and softening of the cartilage cells. This was followed by fraying and degeneration.

Schmidt (1946) immobilized the legs of dogs with experimental arthritis by placing them in plaster casts. He claims that atrophy of the immobilized arthritic legs is much more extensive than is that of immobilized control limbs. He stresses the point that muscular atrophy is due not so much to muscular inactivity of the affected limbs, the importance of which he clearly recognizes, as to the toxic effect of the disease on those nerves which regulate the growth and nutrition of the muscles, the so-called trophic nerves. Landoff (1942), to the contrary, finds that immobilization of the arthritic extremity of rabbits does not lead to an increase in atrophy; instead the fixation appears to protect the extremity from atrophy, which in his observations does not reach the same degree as when the arthritic extremity is left free and unprotected. These divergent results can only mean that further work is necessary for the solution of the problem of inactivity and before such observations can have much practical significance.

The investigations of Martin, et al. (1946), on vasomotor adaptability in patients with rheumatoid arthritis are of significance as physical therapy is an important adjunct in the treatment of this condition and the rationale of its use is elucidated in respect to circulation. Many authors have reported on the sluggish state of the peripheral circulation of patients with this disease and almost instinctively they avoid exposure to cold when possible. The occurrence clinically of vasospastic abnormalities including Raynaud's syndrome has been frequently cited in this group of patients. The studies of Martin and associates indicate, however, that there is not a constant defect in vasomotor adaptability. Objective evidence of cold intolerance is provided for they found that vasoconstriction is sluggish and incomplete upon exposure to cool environments. The rationale for the use of heat is thus apparent.

Several other findings of Martin and associates are likewise noteworthy for by such careful clinical research, empiricism can be eliminated from the prescription of physical medicine. Dry and moist heat are equally effective in raising cutaneous temperatures and the simple procedure of a hot tub bath produced vasodilatation in the hands and feet of even longer duration than local applications of heat. Massage, as might be anticipated, also increased the temperature of the extremities treated to a lesser and varying degree.

IX. Abuse of Rest

The abuse of rest as a therapeutic measure has been condemned in recent years by a host of writers. Among these, as mentioned by Krusen (1945), are Menninger, Krause, Rusk, Harrison, Eastman, Powers, and Dock. Ghormley (1944), was perhaps one of the first to call in question the emphasis placed on rest by Hugh Owen Thomas and cites the many disadvantages of inactivity as compared with early activity in the orthopedic field.

A critical and well-controlled study of early postoperative ambulation was made at Peter Bent Brigham Hospital on patients having major intra-abdominal surgery. A total of 681 cases were analyzed for postoperative complications and their causative factors. Blodgett and Beattie (1946), who report these studies, state that the patients who rose early were considerably stronger and had less pain. Early rising is defined as rising and walking on the first or second post-operative day. Those who rose early were able to care for themselves on about the fourth post-operative day and were ready for discharge considerably earlier than the control group. The incidence of wound disruption and wound infection was reduced in the early rising group. The incidence of pulmonary complications was somewhat lower in the early risers. However, the incidence of deep leg vein thrombophlebitis was observed to be somewhat greater in this group.

Robertson, Schmidt, and Feiring (1946) report observations made on 200 patients on whom the diagnosis of acute rheumatic fever was made by the clinical and laboratory criteria recommended by the Army Air Forces. Early ambulation

greatly reduced the incidence and severity of anxiety neuroses. The usual clinical and laboratory criteria for judging activity of the disease were not regarded as contraindications for starting early ambulation—the patient's physical comfort was the determining factor. The authors recognize that their study does not warrant any dogmatic conclusions, nor do they advocate indiscriminate physical activity. Nevertheless, they believe that it does invite attention to re-evaluation of the currently accepted policy of prolonged bed rest, with its disadvantages, in the treatment of acute rheumatic fever.

Karpovich and associates (1946) also found that patients convalescing from rheumatic fever in an AAF hospital could safely participate in a graded system of physical exercises within two weeks after clinical cessation of the pathologic rheumatic activity. The conventional delay in the beginning of physical reconditioning was reduced from 77.3 days to 16.2 days without causing an increase in the incidence of cardiac damage during six to twelve months of observation.

In the study of convalescence, two definite questions need answers: (1) To what degree does treatment by rest in bed contribute to the abnormalities found in patients convalescent from trauma and disease? (2) How can the end of convalescence be determined?

A group of workers at Cornell University (1945) have answered these questions by making a quantitative study of some of the chemical, physiological and psycho-biological disturbances produced in four normal men subjected to prolonged bed rest and immobilization, and by modifying these changes by the use of a motor-driven oscillating bed during the period of immobilization.

During the bed rest period, lasting 6 to 7 weeks, the degree of immobilization was standardized by placing the men in bivalved plaster casts extending from the umbilicus to the toes. They remained in the casts except during bowel movements and during tests spaced at long intervals. In the recovery period of 4 to 6 weeks the subjects were ambulant on the sixth day and resumed the same degree of activity as in the control period at the end of two weeks.

Elaborate, well-controlled balance studies were carried out. Fecal nitrogen, calcium, phosphorus, sodium, and potassium were estimated. Urinary nitrogen, calcium, phosphorus, sodium, potassium, sulfur, creatine, creatinine, and pH were determined daily. Also a considerable number of functional studies were made on circulation responses on assumption to the standing position, and on muscle power, muscle atrophy, basal metabolism, and blood volume.

The results showed:

1. Significant losses occurred in nitrogen, calcium, and phosphorus during bed rests; retention of these elements resulted in the recovery periods following.

2. Urinary calcium levels more than doubled during immobilization (average 342 mg. daily) without compensatory changes in urinary citric acid and pH which would increase the solubility of calcium. Likewise, the pH became higher in face of larger amounts of calcium in the urine, tending to favor calcium insolubility and stone formation.

3. Although creatine and creatinine excretion remained fairly constant, there was a definite lowering of creatine tolerance tests during bed rest. This close correlation would seem to indicate that no unusual form of protein was being destroyed during immobilization.

4. The principal effect upon the circulation was the deterioration of postural circulatory mechanisms, as shown by an increased tendency to faint in tilt table tests during the bed rest period.

5. As a result of immobilization there was atrophy of the immobilized leg muscles, and a decline in muscle strength which was more marked in the immobilized areas. There was a decline in basal metabolism of about 10 per cent and a decrease in blood volume averaging 5.2 per cent.

They repeated the studies on two men substituting an oscillating bed for the ordinary fixed bed, with the following results:

1. Significant reductions were brought about in the total calcium losses of immobilization. Urinary calcium excretion increased less than half as much as it did in the fixed bed experiments.

2. The nitrogen loss of immobilization was reduced by half in one subject, was unaltered in the other subject. The phosphorus loss was reduced. Creatine tolerance tests were improved.

3. Use of the oscillating bed tended to prevent the deterioration of postural circulatory mechanisms; there was a decreased tendency to faint on tilt table tests during the bed rest period.

We are thus finding evidence of the value of therapeutic physical and mental activity to offset the old conceptions of the value of rest as a therapeutic measure. Krusen (1945) has stated: "It is apparent that many physicians have abused rest as a therapeutic procedure. Let us not abuse therapeutic activity in a similar fashion. There is a logical middle ground toward which we are now groping, but we will not find it until we have shaken off the prejudicies and misapprehensions of the past. For the sake of our patients we must strive valiantly to achieve a correct balance between rest and activity in therapy."

In conclusion, an attempt has been made to summarize some current literature dealing with muscle, nerve and bone. Much of that related may prove to be without value. Some will probably withstand the test of further work. A fragment of the whole, let us hope, will stimulate clinical research into the much greater unknown. This is the way medicine progresses.

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PHYSICAL THERAPY IN RELATION TO MILITARY MEDICINE: ITS USE IN A GENERAL HOSPITAL*

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This paper will discuss and outline in general terms the application, organization and utilization of physical therapy in military medicine. The development of this branch of medicine and type of treatment during the past three decades has truly been phenomenal. In this development, the Army Medical Department has played an important role, due in large degree to exigencies and requirements resulting from disease and injury of two world wars. That some benefits do accrue to mankind as a result of conflict can hardly be denied. When man is confronted with the necessity for self-preservation, his ingenuity and inventiveness are highly stimulated and advances are made which make for a more comfortable and enlightened existence after a period of conflict has passed. So it is in the field of medicine where our knowledge in many fields has been advanced by many years. The new management of shock and excessive environmental changes are pointed examples. So, too, are the advances which have been made in physical medicine which has been definitely advanced and stimulated as a result of the problems arising out of the last great conflict. It would be a distinct exaggeration to say that the present upsurge of interest in physical medicine is a result of the war, but it cannot be denied that the application and interest of the armed forces in this particular field of medical development has done much to establish its professional and therapeutic standing.

Physical medicine which is interpreted by the armed services to include physical therapy, physical reconditioning, and occupational therapy, constitutes an integral part in the professional management of the sick and wounded. Because it is our purpose in the Army Medical Department to return a

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patient to duty, fit for duty, physical medicine is the keystone in a rehabilitation program designed to accomplish these ends. It is not the purpose of this discussion to enter into the entire ramification of army physical medicine, but primarily to discuss physical therapy as it is applied and available in the army hospital.

The important part physical therapy plays in a properly rounded treatment program has long been recognized by medical men in the army. The Physical Therapy Department is an essential feature which is built into all army hospitals in this country, and similar although less elaborate installations have been made a part of all of the temporary overseas hospitals. Many of the army general hospitals in this country have extensive physical therapy departments to which patients from lesser installations are transferred so that they may receive the benefit of highly specialized apparatus and treatment procedure. Physical therapy is always under the direction of a medical officer, and in our general hospitals, is a part of the Physical Medicine Service. Physical therapists conduct the treatment after the patient has been examined and appropriate treatment prescribed. These therapists are specially trained and have rigid minimum requirements to meet before they can become qualified in their chosen field. The fact that trained nurses have recently found this medical specialty of considerable interest and have, as a result, become trained physical therapists in their own right, has increased the standard of excellence, and has brought additional experience and training to bear on a highly specialized problem. The number of physical therapists appointed in the Medical Department of the United States Army increased from 289 on 31 March 1943 to 1,632 on 1 March 1946. About 1,000 of these received either their entire professional training or completed periods of apprenticeship in the courses in physical therapy offered by the Medical Department of the Army. Such a school for physical therapists was conducted at Fitzsimons General Hospital during this period of time under the direction of Major O. L. Huddleston, M.C., the ninth and last class being graduated on 10 May 1946. These therapists all served

admirably and well during their period of military service, and many of them have remained on active duty with plans to make physical therapy in the Medical Department of the Army their permanent career. The passage of proposed legislation to commission these officers in the Women's Specialist Corps as a part of the regular peace-time army which is now being established will provide them their proper place.

The statement has often been made in medicine: "It is not the treatment but the person rendering it." This fact is especially true in the use of physical agents, and much more important than the agents themselves are the persons who bring them to the patient. The technique of procedure determines the safety of their application and effectiveness, and in this regard, the army physical therapist has established a very high level of performance.

Physical therapy needs no introduction in the treatment of trauma, and occupies an old and important place in the various phases of physical rehabilitation of war injuries. The type of physical therapy prescribed, the time it is employed, and the technique of its utilization are the factors which determine its ultimate value in any given case. Physical therapy most commonly used is neither new nor complicated and the effects to be anticipated from its employment are definite and predictable. The commonly employed agents include exercise, electrotherapy, heat, massage, and radiation. Many other specialized procedures and treatments have been devised in special cases and for special needs, such as electrical stimulation in nerve injuries and ion transfer for the restoration or change of electrical balances in the system, but these are special fields requiring detailed examination and study.

Physical therapy, regardless of type, is prescribed as definitely as possible, and good physical therapy depends on attention to detail in carrying out the prescription. The prescribing of physical therapy in any army general hospital is the duty and responsibility of the Chief of the Physical Medicine Service or an especially trained Medical Corps Officer under his immediate direction and supervision. Close liaison is maintained with the other services and sections through the use of

demonstrations, clinics, staff conferences, special training programs, and ward rounds. An effort is maintained at all times to develop and enlarge the coöperative spirit which characterizes the relationship of all the services in the professional management of any patient. For example, before a patient is subjected to lobectomy, he is carefully studied by the Medical and Surgical Services and a final determination for surgery is made at a chest surgery conference at which the physiatrist and physical therapist are present. The patient's history and physical findings are carefully reviewed and any special problems in rehabilitation are discussed before the patient is scheduled for operation. In this way, the problems of the surgeon and the physical therapist are carefully outlined and the patient is acquainted with each of the steps required in his operation and rehabilitation procedure. Scheduled ward rounds permit the opportunity for familiarization and indoctrination in the use of physical therapy to the uninitiated medical officer as well as providing the opportunity for close study of the patient and his response to the physical therapy measures which have been instituted. Discussions about unusual patients often result in a change of the physical therapy prescription and serve to obviate any differences in medical opinion and professional management between the medical services concerned with their care.

I shall now discuss in further detail the operation of the Physical Therapy Department at the Fitzsimons General Hospital. You are no doubt familiar with the Army Medical Department plan which designates certain of the general hospitals as specialized centers for the treatment of definite classes of disease and disability. Fitzsimons General Hospital has been designated as a chest surgery center as well as a center for the treatment of tuberculosis of all kinds. The third large class of patients seen constitute the orthopedic disabilities. There is also a large neuropsychiatric, diagnostic and treatment service, and it is from these four services that we draw the majority of our patients. The Medical Service is primarily concerned with the diagnosis and treatment of pulmonary tuberculosis which requires little physical therapy

although the other specialties utilize such treatment to a considerable degree.

Surgery, particularly chest surgery and orthopedic surgery, plays a major role in the treatment of war injuries. The chest surgery program and the physical therapy program designed as an adjunct to it have been well described elsewhere, but a brief review may not be amiss. After the determination for chest surgery has been made, the patient is visited in his room or ward by the ward physical therapist and the physiatrist, at which time an attempt is made to secure his complete coöperation and to give him assurance regarding the result he may expect from his operation and the treatment following it. A careful attempt is made to explain his need for coöperation and the benefits to be obtained from it. Corrective breathing, body alignment, posture in bed, and the active use of arms and shoulders through the full range of motion, is described and demonstrated and the patient is informed that these procedures will be required immediately following surgery.

The treatment regime of patients following pulmonary resection may be divided roughly into four stages: (1) the preparation of the patient for operation, (2) the immediate post-operative convalescent care or bedside physical therapy, (3) the physical therapy period in the Physical Therapy Department, and (4) the period of reconditioning preparatory to hospital discharge and return to duty. The problems to be overcome include a lowered vital capacity as the result of pulmonary resection, a decrease in stamina and strength which is incidental to protracted debilitating disease or injury, postural defects, and the loss of motive power of large muscle groups, incidental to the extensive muscle-cutting incision employed at the time of operation. After the patient returns from the operating room following pulmonary resection, he is visited several times daily by the physical therapist who pays special attention to body alignment, positioning in bed, chest and shoulder motility, and the proper use of pillows. On the second post-operative day, the patient is ready for certain physical therapy procedures including breathing exercises,

passive motion, and the use of heat and massage as is indicated. On the seventh post-operative day, the patient is ready for more active physical therapy and reports to the Physical Therapy Department where he is re-examined by the physiatrist who determines any special needs which may exist in the individual case.

The breathing and shoulder exercises previously instituted on the ward are continued in the clinic along with the use of abdominal and postural exercises and special treatment of the severed muscle groups in the form of hot packs of the Kenney type, together with special attention to the operative scar as may be required. The abdominal, breathing, and posture exercises are given in the carbon arc ultraviolet room and general carbon arc ultraviolet irradiation is given as an added procedure to stimulate general immunity reaction and increase the patient's general strength and reserve. The shoulder exercises are unilateral and are confined to the operative site unless special indications exist for the use of bilateral exercises. The purpose of these exercises is to prevent contracture and limitation of range of motion of the shoulder joints and to restore muscle power. They are a modification of the heavy resistive type of exercises designed by Thomas L. DeLorme for the restoration of function to muscles disabled and weakened as a result of injury.

The military orthopedic patient is a problem of special concern to the Army Medical Department because of the prolonged period of hospitalization, the need for intensive rehabilitation, and the residual physical disability and deformity so often encountered following injury. Since Fitzsimons General Hospital is a hospital of the zone of the interior, it constitutes one of the terminal echelons of the Medical Department of the Army of the United States. Most of the patients seen by the Orthopedic Section of the Surgical Service have been transferred many times since the inception of their original injury on the battle line or with the army of occupation in the various sections of the globe. Such patients must either be cured and restored to physical status permitting active military duty, or discharged from the army on a certifi-

cate of disability which is issued to those physically unfit to render further useful service to the army.

One of the functions of a General Army Hospital is that of making the proper disposition of patients, including orthopedic patients, and it is in the execution of this particular mission that physical therapy finds one of its greatest scopes of usefulness. By assisting the Orthopedic Section in making a final evaluation of a given patient as regards degree of permanency of disability, loss of function including motive power, and loss of range of motion, proper disposition is accomplished. In the final measurement or determination of these residuals, the functional occupational therapy shop plays an important role, and its use in this manner has been adequately described by previous writers. The Orthopedic Surgeon is primarily concerned with the correction and prevention of deformity, and it thus becomes the duty of the physical therapist to maintain and restore function. Following the original injury, physical therapy procedures are instituted early in the treatment of any patient. Such treatment will include heat, massage, motion, and special procedures such as the use of contractile electrical currents for the production of minimal muscle contractions *without* joint motion or disturbance of the site of fracture. The importance of this special procedure in the restoration of function in soft tissues injured at the time of fracture has been emphasized by Smart and others.

By the time an orthopedic patient has arrived at a general hospital in the zone of the interior, he has usually been subjected to various surgical and therapeutic procedures, but many cases still require the use of intensive physical therapy. Patients with loss of motor power and muscle and joint capsule contracture resulting in limitation of motion will require high resistive and underwater exercises. Special procedures in the form of short-wave diathermy to aid callus formation in the presence of delayed or non-union, ultraviolet radiation for decubitus, chronic skin infections, and persistent draining sinuses, and local treatment for osteomyelitis may be indicated. Manipulative procedures are often required for full

restoration of joint function. Orthopedic disabilities complicated by nerve injuries and muscle paralysis constitute a special problem and require additional physical therapy in the form of electrical stimulation to the involved muscles and nerves as well as muscle re-education. Tendon transplants also require prolonged treatment in the form of muscle re-education. The closest possible liaison exists between the Physical Medicine Service and the Orthopedic Section and is maintained in the manner already described. It is extremely important to obtain the closest coöperation with the Chief of the Orthopedic Section and his ward officers so that physical therapy may be utilized to its fullest extent at the earliest possible moment in the case of any given patient.

A brief word regarding the role of physical therapy in the management of our general surgical patients seems appropriate. Physical therapy has much to offer the general surgeon in the care of his patient. In elective surgery, for example, the patient's circulatory status may be improved and stimulated and his resistance to infection enhanced by the judicious use of physical measures prior to the operative procedure. Vasomotor control and stability is improved by the use of hydrotherapy; local application of heat is used in the control of infection as in abscesses, carbuncles, and cellulitis; heliotherapy and radiation therapy have definite tonic effects and also enhance the patient's resistance to upper respiratory infections. In special cases, the use of exercise and massage will be indicated. After-care of the surgical patient is facilitated, post-operative pain can be effectively reduced, and wound healing can be hastened by the judicious use of heat. Local applications of cold find their place in the control of hemorrhage, and in the slow healing surgical incisions ultraviolet radiation provides not only a bacteriacidal effect but also directly stimulates such healing. In the management of second degree burns, the use of a combination of ultraviolet and infra-red radiation has been found definitely stimulating and promotes healing by the growth of healthy granulation. The incidence of embolism, pulmonary and systemic, and the occurrence of phlebo-thrombosis can be markedly reduced by

circulatory stimulation through the aid of exercise including deep breathing exercises, massage, motion of the passive type, and proper positioning in bed. Not only does the appropriate use of physical therapy have value for stimulating the various physiological processes in the surgical patient, but it also produces a distinct psychological effect making the patient feel that every effort is being put forth to speed his recovery.

The general Surgical Service annually sees large numbers of extra-pulmonary tuberculosis patients who require intensive physical therapy procedures in addition to surgical procedures before the patient can be healed and proper disposition made. Heliotherapy and general and orificial ultraviolet radiation have been found beneficial in the management of tuberculous genito-urinary disease, and tuberculous peritonitis. The professional management of contusions, hematomas, and sprains also require physical therapy procedures for relief. The edema, pain, muscle spasm, swelling, and impaired function present in such soft tissue injuries respond well to early treatment. The use of analgesics and anesthetics through iontophoresis in the treatment of muscular strains and sprains has marked a definite improvement in therapy and has resulted in the early return to duty of such patients. Gynecologic problems, particularly chronic inflammation of the pelvis, are frequently seen in the Physical Therapy Department, and often respond well to conventional or long-wave diathermy. Such conditions are often complicated by low back pain and postural defects which respond to a routine of therapeutic exercises.

In the field of neuropsychiatry, physical therapy as a method of treatment has long occupied a prominent place and it is to this specialty that physical therapists are somewhat indebted for their preservation during that period of medical history when the charges of charlatanism and quackery were constantly being leveled by the uninformed. The use of hydrotherapy in the form of sedative packs and stimulative baths, douches, and sprays, are familiar to all. Later there was added the use of fever therapy by physical means for the treatment of paresis, and today, the use of pharmacologic shock has

largely been surplanted by the use of electro-shock for the treatment of many of the functional psychoses. More recently, improved hydrogalvanic apparatus has made it possible to employ the hydrogalvanic bath in the treatment of the neuroses, psychoneuroses, polyneuritides, and tabetic paresthesias. Very satisfactory responses have also been seen with its use in the treatment of combat exhaustion and nervous exhaustion due to war strain. As was true in previous contacts, the same type of liaison must be maintained between the Physical Therapy Department and the Neuropsychiatric Service, and is accomplished in the same manner. It can be safely said that military medicine has found the use of physical therapy of definite advantage in the management of the neuropsychiatric patient, hastening his recovery and allowing many of them to return to a useful civilian status at an earlier date than was formerly possible.

While physical therapy does not play as extensive a role in its relationship to the Medical Service including internal medicine and its sub-specialties, it has been found of definite benefit in the diagnosis and management of certain medical conditions including arthritic, dermatologic, and opthalmologic conditions. Certain diseases of the circulatory system, particularly the peripheral vascular diseases, also require intensive physical therapy if managed properly. Physical therapy in such conditions, properly prescribed and used, not only relieves symptomatology but also materially and measurably reduces residual disability. Since our Medical Service sees annually rather large numbers of patients in the higher age groups, including veterans of the first World War, the incidence of peripheral vascular diseases is high and the Physical Therapy Clinic provides these patients with treatment in the form of contrast baths, exercises, oscillating beds, intermittent venus pressure devices, and suction pressure machines. Diseases of the respiratory tract, particularly asthma and bronchitis, also are referred for physical therapy which is prescribed in the form of special deep breathing exercises, posture exercises, short-wave diathermy, and ultraviolet radiation.

It can be categorically stated that physical therapy is of great value therapeutically in the management of many forms of arthritis. Its method of use and the results to be expected have been described by Krusen and others, and no further discussion of this type of physical therapy will be made except to say that it occupies an important place in military medicine in the management of this disability. The Medical Department has set up special hospitals and centers for the treatment of arthritis including the Army and Navy General Hospital at Hot Springs, Arkansas, where physical therapy, including the use of special baths, has been found of value.

The Dermatologic Section of the general Medical Service sees frequently for diagnosis and treatment persistent skin diseases, particularly fungus infections, and many referrals and requests for appropriate physical therapy originate in this section. Treatment includes particularly ultraviolet radiation and iontophoresis with heavy metals. Problems in diagnosis are frequently referred for examination for fluorescent phenomena and such examinations are now standard by the use of a Wood's type filter or inspectoscope. Skin blemishes are treated by the use of electro-surgical procedures including coagulation, epilation, and fulguration.

Opthalmologic conditions, particularly corneal opacities and ulcerations, and ocular infections, respond well to physical therapy procedure in the form of iontophoresis, using mild zinc solution, in the treatment of corneal opacities, and short-wave diathermy in the treatment of infections. Many referrals are seen weekly for opthalmologic conditions due perhaps in part to the fact that military personnel lead an active outdoor life, frequently sustaining foreign body injuries to the eyes. The response of such conditions to the proper physical therapy procedures is invariably good. The same type of liaison is maintained between the general Medical Service and its auxiliaries as is maintained with the other services through the same methods. In our experience, greater care is required in the proper prescribing of physical therapy procedures for the general medical patient, since the problem of diagnosis remains ever-present.

The history of physical therapy in military medicine closely parallels the history of its development in civilian use. Its development is also intimately associated with the needs and progress of both World Wars. The first proposal was made on 14 August 1917 to the then Surgeon General, Major General Gorgas, and as a result there were submitted to the Secretary of War on 7 November 1917 tentative plans for standard physical therapy units for base and general hospitals which were to be equipped for hydrotherapy, electrotherapy, mechanotherapy, and a therapeutic gymnasium. By May 1919, 45 general hospitals were equipped with physical therapy departments and were staffed with 700 so-called physiotherapy aides. Later these personnel became known as reconstruction aides and included occupational therapy aides. The development of physical therapy during the peace between World Wars I and II closely paralleled its development in civilian institutions, the therapists employed being qualified therapists in civilian status. Early in 1942, a congressional act conferred relative military rank on physical therapy aides, and in 1944, full military rank was granted in the Medical Department of the Army so that physical therapists are now commissioned officers and carry the designation of Physical Therapist. The maximum number of physical thrapists appointed in the Medical Department of the Army was 1,632 in March 1946, and the largest number of these to do duty overseas at any one time was 569, in June 1945. The Physical Therapy Department at Fitzsimons General Hospital closely parallels in its development the history of physical therapy in the Medical Department of the Army. It was originally organized as a part of the Orthopedic Section of the Surgical Service and was later incorporated into the Surgical Service as a separate section responsible for physical therapy, physical reconditioning, and rehabilitation, and continued in that status until 9 August 1946, when it was incorporated in a Physical Medicine Service which included physical therapy, physical reconditioning, and occupational therapy. This reorganization followed

the lines of War Department Circular No. 349 which is quoted in part as follows:

"Physical medicine includes the coördinated and integrated employment of physical therapy, occupational therapy, and physical reconditioning, in the professional management of the sick and wounded. This method of treatment has achieved its present standing because of the beneficial results obtained by its use in definitive medical care, and in shortening the period of convalescence. The mission of the Physical Medicine Service is to carry out scientifically and efficiently the utilization of these therapeutic adjuncts aimed toward improved care and more rapid convalescence. . . . All patients referred to the Physical Medicine Service will be seen by the Chief of the Service or his medical assistant who will prescribe the treatment on the proper form. . . . It is of the greatest importance that representatives of the Physical Medicine Service maintain close liaison with the ward surgeon, the medical officer, or the Chief of Service who has referred the patient to the Physical Medicine Service."

The Physical Therapy Department in our hospital is adequately housed and at present occupies the ground floor in the east wing of the new hospital building which was dedicated on Pearl Harbor Day, 1941. The floor space of roughly 11,400 square feet is laid out in the form of an "L," both limbs of which are about equal in size, and is given over to offices for the Chief of Service, two medical assistants, and the Chief Therapist, therapists' rest room, aides' rest room, a library, enlisted men's locker room, patients' locker room, lobby and waiting room, two ultraviolet light therapy rooms, massage clinic, gymnasium, hydrotherapy rooms including Hubbard tub room, steam cabinet bath room, electric cabinet bath room, short-wave diathermy room, and whirlpool bath room. Additional space is required for utility rooms, preparation and storage rooms, and linen closets.

The work of the Physical Therapy Department is divided into two large groups: the clinic program and the ward program. The clinic program provides for physical therapy treatment to ambulatory hospitalized patients as well as a large out-patient service. Patients in out-patient status are referred from sick call. The ward program provides physical therapy

treatment for bed patients who are unable to come to the clinic and is confined largely to the chest surgery and orthopedic wards to provide pre-operative and post-operative care for patients undergoing these types of surgery. The program of convalescent and therapeutic swimming and underwater exercises was suspended during the polio epidemic in Colorado but was resumed early in December 1946 and again furnishes additional types of treatment for orthopedic patients. An idea of the workload of the Physical Therapy Department can be gained from the following annual statistics for the calendar year 1946:

Number of new patients admitted	3,475
Number of patients discharged	3,215
Total number of treatments given	140,287
Massage	28,745
Thermotherapy	15,160
Therapeutic exercise	50,090
Hydrotherapy	22,102
Electrotherapy	12,966
Actinotherapy	11,224

HOSPITAL PATIENTS

Section	(Clinic) Army	VA	Civ	(Ward) Army	VA	Civ
Orthopedic	1288	111	18	300	99	4
General Surgery	260	42	2	140	18	....
Septic Surgery	8	2	....	....	....	....
General Medical	320	60	4	186	54	6
G.U. Surgical	54	4	....	....	....	....
E.E.N.T.	12	....	....	....	....	....
Dermatology	20	6	2	....	....	2
Neuro Psychiatric	36	4	....	....	....	....

OUT-PATIENTS

Army	287
VA	4
Civ	122

In conclusion, it can be stated that physical therapy is of great value in the healing of disease and restoration of function in patients who are the responsibility of the Army Med-

ical Department and it occupies a very high place in military medicine. Much credit for its present status must be given to the far-seeing medical leaders in the Medical Department of the Army who have recently organized the Physical Medicine Service of which physical therapy is an integral and important part. Distinguished civilian physiatrists have been appointed consultants to the Secretary of War and their recommendations are being utilized by the Surgeon General of the Army in the operation of his Medical Department training program which is designed to furnish new, well-qualified medical officers for the peace-time army. The future of Physical Medicine in the army is assured.

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THE ANTIGENIC RELATIONSHIP OF LYMPHOGRANULOMA VENEREUM AND PSITTACOSIS BY SKIN TEST IN HUMANS*

MORRIS POLLARD AND T. M. WITKA

Recent evidence indicates that the disease agents which are referred to as the "Lymphogranuloma venereum-psittacosis group" are related by a homologous antigenic component which can be demonstrated by the complement-fixation technique. This serological relationship has been demonstrated with the agents of lymphogranuloma venereum, psittacosis and meningopneumonitis (Rake, Eaton & Shaffer; Eaton, Martin, & Beck). The skin sensitizing relationships among these agents has not yet been completely clarified. A skin sensitizing antigenic relationship has been demonstrated in rabbits with the viruses of psittacosis and meningopneumonitis (Morgan). Herein is presented a study of the relationship between the agents of lymphogranuloma venereum (LGV) and psittacosis in humans.

METHOD

Patients who were admitted to the venereal diseases clinic of an Army hospital, for diagnosis and therapy, were tested simultaneously with commercial chick embryo Frei skin test antigen[1] (Grace, Rake & Shaffer), normal chick embryo control antigen and with an antigen prepared with the P4 psittacosis agent.[2] The P4 agent was inoculated into the chorio-allantoic cavity of 7-day old chick embryos and after four or five days further incubation at 35° C., the chorio-allantoic fluid was collected, pooled, and inactivated at 56°/30 minutes. This was then centrifuged at 6000 rpm/1 hour. The sediment was then resuspended in saline at 1/10 its original volume and this constituted the psittacosis skin test antigen. Suitable animal inoculation tests were made to be certain that the agent was no longer viable.

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*From the Virus Research Laboratory, The University of Texas Medical Branch, Galveston. Received for publication, March 11, 1947.

[1]Lygranum S.T. purchased from E. R. Squibb & Co., Inc., New York, New York.

[2]This agent was kindly furnished by Dr. Joseph E. Smadel.

Two groups of patients were selected: one group consisted of clinical cases of LGV; the other group consisted of known syphilis cases (based on a positive serology for syphilis) and patients who had non-specific venereal lesions from which LGV had been ruled out.

A blood specimen was collected from each patient and it was subsequently examined for syphilis, psittacosis, and LGV. Each patient was inoculated intra-dermally with the test antigens. The Frei antigen and its control were inoculated into the volar-surface of the right forearm and the psittacosis antigen similarly into the left forearm. These individuals were thereafter examined every 24 hours for the next 3 days.

A positive Frei test was based on the customary induration and peripheral erythema at the point of inoculation. A positive skin test was further confirmed by a negative test with the control normal antigen.

Eight clinical and six suspected cases of LGV were tested with the three antigens noted above. In addition, 8 syphilis cases, 3 suspected syphilis and five penile ulcer cases were similarly tested.

Results

Eight laboratory confirmed clinical cases of LGV responded to the psittacosis skin test antigen with severe reactions, ranging from severe erythema and induration to severe axillary pain. Six suspected LGV cases, of which two were confirmed serologically, resulted in indefinite and inconsistent reactions. Five cases of penile ulcer, eight cases of syphilis and three suspected syphilis cases were to great extent negative to both Frei antigen and psittacosis antigen. One penile ulcer case demonstrated a similar response. We have not attempted to interpret the latter findings.

Discussion

An extensive erythematous and indurative reaction characterized the skin test responses to psittacosis antigen in the majority of LGV cases. Five of the eight cases so tested complained of pain under the arm and enlargement of the cubital

and axillary lymph nodes. This was either absent or minimal with those individuals who did not have LGV infection.

It appears from the results of this study that LGV and psittacosis are related by homologous skin sensitizing antigens and that the skin test would not aid in the differential diagnosis of a case of LGV or psittacosis. It would not be of value in the definitive diagnosis of a case of psittacosis in an individual who has LGV infection. On this basis the skin test does not appear to be any improvement of the currently used complement fixation test for LGV or psittacosis. The severity of the skin reaction might be considered by some as an improvement over the currently used commercial lygranum but it will be noted that this enhanced reaction elicited occasional responses in negative LGV cases; so this matter is one of personal judgment.

The information presented herein serves to emphasize the difficulty which one encounters in attempting to differentiate members of the LGV-psittacosis group of disease agents by the methods currently available.

Summary

A skin sensitizing antigenic relationship between LGV and psittacosis has been demonstrated by inoculating cases of the former disease with antigens prepared from the latter one. The responses are severe and relatively specific. Differentiation of these two diseases by this method does not appear to be practical.

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CASE NO.	DISEASE	HOURS	LGV ERYTH	LGV IND	NORMAL YS ERYTH	NORMAL YS IND	PSITTACOSIS ERYTH	PSITTACOSIS IND	COMPLEMENT FIXATION LGV	PSITT	KOLMER
1	LGV	24	2.0 cm.	++	0.5 cm.	0	*10.0 cm.	++	+	1:80	....
		48	2.0	++	0.5	0	4.5	+++			
		72	2.0	+	0.5	0	2.5	+			
2	LGV	24	1.5	++	0	0	* 5.0	++	1:20	1:40	....
		48	2.5	+++	0	0	10.0	++++			
		72	0	+	0	0	0	0			
3	LGV	24	2.0	++	0	0	*10.0	+++	1:80	1:640	....
		48	0	0	0	0	8.0	++			
		72	0	0	0	0	0	0			
4	LGV	24	2.0	++	0	0	5.0	+++	1:160	1:160	....
		48	2.5	+++	0	0	8.0	++			
		72									
5	LGV	24	2.0	++	2.0	0	*12.0	++++	+	+	I.Q.
		48	2.0	++	1.0	0	13.0	++++			
		72	2.0	++	1.0	0	2.0	0			
6	LGV	24	0.5	+	0.5	....	12.0	+++	1:40	1:160	....
		48	2.0	++	0.0	0	5.0	+			
		72	2.0	+	0	0	0	0			
7	LGV	24	2.0	++	0	0	2.0	++	1:40	1:160	....
		48	1.5	++	0	0	2.0	++			
		72	1.5	+	0	0	1.0	+			
8	LGV	24	2.0	++	0	0	2.5	++	1:40	1:160	....
		48	2.0	+	0	0	2.5	++			
		72	0	0	0	0	2.5	+			
9	LGV	24	0	0	0	0	0	0	1:160	1:320	....
	suspect	48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			
10	LGV	24	1.5	+	0	0	10.0	+++	....	1:5	....
	suspect	48	1.0	+	0	0	1.0	++			
		72	0	0	0	0	0	+			

CASE NO.	DISEASE	HOURS	LGV ERYTH	LGV IND	NORMAL YS ERYTH	NORMAL YS IND	PSITTACOSIS ERYTH	PSITTACOSIS IND	COMPLEMENT FIXATION LGV	PSITT	KOLMER
11	LGV	24	0	0	0	0	0	0	....	....	....
	suspect	48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			
12	LGV	24	0	0	0	0	0.5	0	....	....	4+
	suspect	48	0	0	0	0	0.5	0			
		72	0	0	0	0	0	0			
13	LGV	24	1.0	0	1.5	0	5.0	++	1:10	1:160	1+
	suspect	48	2.0	++	0	0	5.0	+++			
		72	1.0	0	0	0	2.5	++			
14	LGV	24	8.0	++	0	0	10.0	++	1:5	1:10	....
	suspect	48	10.0	++	0	0	14.0	+++			
		72									
15	Penile	24	0	0	0	0	0	0	....	....	....
	ulcer	48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			
16	Penile	24	1.0	+	0	0	8.0	+++	....	1:5	....
	ulcer	48	0	0	0	0	5.0	++			
		72	0	0	0	0	0	0			
17	Penile	24	0	0	0	0	0	0	....	1:5	....
	ulcer	48	0	0	0	0	0	0			
		72									
18	Penile	24									
	ulcer	48	0	0	0	0	0	0	....	....	AC
		72	0	0	0	0	0	0	0		
19	Penile	24	0	0	0	0	0.5	0	....	....	4+
	ulcer	48	0	0	0	0	0	0			
		72	0	0	0	0	0				
20	Syphilis	24	0	0	0	0	0	0	....	1:5	4+
		48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			

CASE NO.	DISEASE	HOURS	LGV ERYTH	LGV IND	NORMAL YS ERYTH	NORMAL YS IND	PSITTACOSIS ERYTH	PSITTACOSIS IND	COMPLEMENT FIXATION LGV	PSITT	KOLMER
21	Syphilis	24	0	0	0	0	4.0	+	....	....	4+
		48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			
22	Syphilis	24	0	0	0	0	2.0	0	....	1:5	4+
		48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			
23	Syphilis and Darkfield	24	0	0	0	0	0	0	....	....	....
		48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			
24	Syphilis and Darkfield	24	0	0	0	0	1.5	0	....	....	....
		48	0	0	0	0	1.5	0			
		72	0	0	0	0	1.5	0			
25	Syphilis and Darkfield	24	0	0	0	0	2.0	0	....	....	4+
		48	0	0	0	0	0.5	0			
		72	0	0	0	0	0	0			
26	Syphilis and Darkfield	24	0	0	0	0	0	0	....	....	4+
		48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			
27	Syphilis	24	0	0	0	0	0	0	....	....	4+
		48	0	0	0	0	0	0			
		72	0	0	0	0	0	0			
28	Syphilis suspect	24	0	0	0	0	4.0	++			
		48	0	0	0	0	2.0	0			
		72	0	0	0	0	0	0			
29	Syphilis suspect	24	0	0	0	0	0	0	....	....	....
		48	0	0	0	0	0	0			
		72	0	0	0	0	0	0	....	....	....
30	Syphilis suspect	24	0	0	0	0	0	0	....	....	....
		48	0	0	0	0	0	0			

PNEUMONIA IN CHILDREN*

BOYD READING

We do not have an entirely satisfactory classification of pneumonias. Anatomically we speak of lobular, lobar and interstitial pneumonia. This is rather unsatisfactory because it does not give us an opportunity to add new forms and new types as they become recognized. Pneumonias may be classified by the reaction they produce. For instance we recognize the croupous type, or fibrinous pneumonias produced by the pneumococcus, the catarrhal pneumonia often due to virus infection, and the suppurative types resulting from staphylococcus, Friedlander's bacillus and streptococcus infections. The various etiologic agents we recognize at the present time produce certain fairly characteristic reactions. For example, it is known that pneumococcus infections result in inflammatory changes, particularly in the mucosa and the alveoli. The virus agents, the hemophilus influenza and streptococcus infections result in a peribronchitis or a peribronchiolitis with certain amounts of tissue destruction and when we come to the staphylococcus type and Friedlander type we find that there is even more tissue destruction, resulting in multiple abscess or even large abscess formation in the lungs.

Recent improvement in bacteriologic study makes it expedient to classify the pneumonias bacteriologically. In spite of the gaps in our knowledge in this respect, this classification seems fairly satisfactory. In a limited sense, and to those who are unable to apply bacteriologic study to their cases, a rather rough and ready method of classification can at times be established by the response to specific therapy—the sulfonamides, penicillin, or streptomycin. This, however, does not promote scientific advancement in the study of pneumonia. So, when possible, it is desirable to study such cases from the bacteriologic point of view.

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*From the Department of Pediatrics, The University of Texas Medical Branch, Galveston. Presented at the Pediatric Post-Graduate Conference, Galveston, April 2, 1947.

Let us discuss briefly some of these types of pneumonia, beginning with the most common, the pneumococcus pneumonia. This type is responsible for the majority of cases of pneumonia seen in children. In most instances we think of these as being primary, but when these patients are examined carefully we find usually a preceding respiratory infection of short or long duration. The pneumonia itself comes with abruptness and we look upon it as being of a primary nature. The lobar type of pneumonia (pneumococcus pneumonia) occurs usually in children over one year of age. The lobular type occurs most often in the younger individual and in the aged, but we must not forget that the lobar type may occur in the very young infant as well as in the older child.

There are some seventy-five types of pneumonococci. We need not discuss them all. Certain things are rather interesting about them however. We have type specific sera for a certain number of them—about thirty-two. Of these some are effective and some are not. The majority of cases of pneumonia are caused by a relatively small number of these types, so it narrows down the number insofar as our bacteriologic study goes. In infants type XIII occurs in a rather large number of patients. In the older children types I, VI, and XIX are found.

The broncho pneumonic response is more common in infants because of the fact that the type of pneumococcus is in the higher type groups rather than in the lower groups which are found most often in the adult. In most of our pneumonias of the lobar type in children we find that type I is the chief organism responsible.

We are familiar with the sudden onset of symptoms following a very short exposure to chilling. Undoubtedly it plays an important role in the production of pneumonia. Fatigue has been mentioned as an important factor. Of course, we recognize the fact that among children who are malnourished pneumonia is more prevalent. In negroes the incidence of pneumonia seems to be unusually high.

The basic process in the pneumococcus types of pneumonia is the production of its fibrinous exudate chiefly in the alveoli.

This gives rise to what we recognize as the consolidated areas in the lobar and lobular types. It is important to recognize that the lesion usually begins at the periphery of the lung and extends centrally, particularly in the lobar type, which explains, perhaps, the reason that we get at first very few physical signs. Formerly we thought that the lesions began centrally and extended peripherally. That, of course, is true in certain types, but in the lobar type the reverse is usually true.

In the lobular forms there is an inflammatory reaction in the bronchi and bronchioles followed by an extension outward into the alveolar spaces. That accounts for the patchy arrangement that is characteristic of the disease. There is first congestion, then edema and then inflammatory reactions which result in greater or lesser areas of consolidation. The symptoms in children are somewhat more variable than in the adult. There are certain things that the child does not show which are classical in the adult with pneumococcus pneumonia. The sudden onset and continued high fever is usual in the child, but very frequently a patient will have an intermittent temperature with a lobar consolidation and of course that type of fever in the bronchopneumonic form is to be expected. The onset is usually abrupt in either type except that there is usually a mild preceding respiratory infection.

Symptoms of the gastro-intestinal tract are extremely common in the infant or the child who is developing pneumonia. Vomiting, diarrhea and anorexia may mask the prepneumonic symptoms to some extent. The rapid breathing, the grunt, and usually the dilatation of the ala nasi are usually present in pneumonia. Early symptoms may be indistinguishable from those of meningitis and sometimes it is impossible to make a diagnosis at first unless a lumbar tap is done and the fluid carefully examined. We should get away from the term cerebral pneumonia. Formerly we thought that apical pneumonias usually gave rise to cerebral symptoms, but probably they do not any more often than pneumonia in other parts of the lung. At any rate convulsions or meningismus, neck and other meningeal signs are fairly frequent symptoms of pneumonia.

The child as a rule does not have sputum. I have never seen rusty sputum in a child with pneumonia. The sputum is swallowed. The stabbing pain in the chest is not common in children. Cough is not a common symptom of childhood pneumonia of the pneumococcus type and a child may go through his pneumonia, particularly lobar pneumonia, and have no cough at all. This does not apply to the patient with broncho pneumonia. Symptoms of importance are the shallow respiration, the tendency to splint the affected side, the dilatation of the ala nasi, and the grunt.

A physical sign of importance in the lobar type on the affected side is suppression of breath sounds. The second sign we usually find is the presence of fine moist rales which may be very transitory. They may not be heard at all unless you listen to the chest very carefully. Third, there is consolidation and as that disappears the lungs clear rapidly with few or no rales returning. In the bronchopneumonic type there are usually bilateral rales, although they may be limited to one side only. They are usually found at the bases but may be heard from top to bottom. Consolidation can rarely be detected by any clinical means unless there is a confluency of the bronchopneumonic process. Most children will have a leukocytosis. About 10 to 20% will also have a blood stream infection and in those cases the mortality rate is high.

Bacteriemia is more common in infections of types I, II, and III than in other types of infection. In taking the culture for determining the type, the simplest and most effective method is the use of a flexible wire with a swab. Take the culture from the naso pharynx, then make inoculations on the proper media. It is desirable to distinguish a lobar from a broncho pneumonia. A pleural effusion may give rise to diagnostic difficulties. An atelectasis is sometimes confusing. A shift of the heart is important in the diagnosis of the condition. A child often complains of acute abdominal pain in association with early pneumonia. Another complication, empyema, occurs in about 5 or 10%. It is less frequent since antibiotics have become available. We now rarely see it in this hospital unless the pneumonia has been neglected or im-

properly treated. Otitis media of the catarrhal type with the red ear drum is present in nearly all cases. The suppurative types are becoming increasingly rare and mastoiditis is extremely rare as a complication of those infections that involve the middle ear and which are treated with antibiotics.

Tympanites is a symptom which gives some trouble. It indicates a serious infection and energetic treatment for relief should be started as early as possible. Prostigmine and the rectal catheter is useful. Counter-irritants of various sorts applied to the abdomen are of doubtful value. In the infant energetic treatment must be started early because here we have a high mortality rate, at least higher than we do in the older child who usually has a lobar type of pneumonia. In the lobar type the mortality even before we used penicillin and the sulfa drugs was extremely low. It is almost a self-limited disease. A certain small number will develop complications but in most instances recovery follows suitable therapy.

The primary pneumonias respond very well to the sulfa drugs. Sulfadiazine works very well and my feeling is that it should be tried first before penicillin is started. If no response follows penicillin should be used. One advantage in the use of antibiotics is that children with pneumonia can be treated at home with safety. With sulfadiazene, 100–200 mgm./Kg. is the ordinary dose, given orally at first and if that is not effective or if the baby is extremely ill, then the intravenous use of the drug or the subcutaneous use is advised. Oral penicillin is not satisfactory. If it is to be given, ultra-muscular route should be used. Type specific antiserum is, as a rule, not necessary. However, if there is no response to the antibiotics in severely ill children, it may be used effectively.

Oxygen is extremely important. A mistake usually made is to begin it too late. If the baby is restless, thrashing about and breathing rapidly oxygen should be administered regardless of cyanosis or not. It is the best sedative we have in such cases. If it is used or indicated there will be less need for other types of sedation. Oxygen may be given by various methods depending upon the size of the baby, by tent, mask or nasal catheter. In view of recent reports, oxygen should be

given with care, by a qualified anesthetist, in order to avoid lung injury.

Streptococcus pneumonia is usually secondary to such conditions as measles, whooping cough, influenza or the common cold and it usually results in interstitial pneumonia. Pathological lesions, in addition to involvement of the broncho and surrounding tissue, may be alveolar involvement and particularly a supurative lesion in the lung resulting in small abscesses. Clinical manifestations are those of broncho pneumonia except that the child is usually quite severely ill. This is about the only difference from the ordinary primary broncho pneumonia. Physical signs are not materially different. Diagnosis is established only by culture. Empyema is relatively common in this type of pneumonia. The treatment of choice here is penicillin.

Staphylococcus pneumonia results usually from the staphylococcus aureus. It may arise either as a result of a blood stream infection or it may gain entrance to the lungs through the air passages but the results are the same in either case. It is most prevalent in early life during the first few months and there is a tremendous tendency toward the formation of abscesses in the lung. Empyema results with fair frequency in this type of pneumonia. Here again culture is necessary for diagnosis. Physical signs are of no great help unless roentgenographically one is able to distinguish the small multiple suppurative lesions. Penicillin here again is the drug of choice.

Hemophilus influenza pneumonia is thought to be a mixed infection. A virus may initiate it. It may start as an influenzal infection and then secondary invasion may follow resulting in a mixed infection. There is no disease more distressing than this one. The baby has a terrific amount of dyspnea. He develops an emphysema so severe that all the accessory muscles of respiration are employed but he simply can't deflate the lung. He gets cyanotic at first, and then later may develop a pallor. Dyspnea is marked. The clinical picture is a distressing one. It is usually due to Hemophilus B infection. Again in this type of infection there is a tendency to multiple abscess formation. Physical signs are not par-

ticularly important insofar as diagnosis is concerned. Streptomycin therapy would seem to be the drug of choice in combination with specific anti serum and with perhaps sulfadiazine.

Friedlander's bacillus pneumonia is not a particularly common one but here again suppurative lesions occur in the lungs. The child also shows rather marked degrees of tissue destruction, particularly of the bronchioles and bronchi and frequently if recovery takes place bronchiectasis or atelectasis may result. Streptomycin seems to be the drug of choice in this type.

We should say a few words about aspiration pneumonia. Amniotic fluid is aspirated into the lungs of the newborn with a fair degree of frequency. We know that the fetus tends to go through rather rhythmic respiratory efforts during intrauterine life. I doubt very much whether this has anything to do with the aspiration of amniotic fluid that results in a pneumonitis. Perhaps it is more common in children who have anoxia during delivery. In other words, that first gasp before the baby is born results in sucking in of fluid. It is an extremely serious thing and when it once develops it is difficult to eliminate. Prophylaxis is most important in this condition. Thorough clearing of air passages as soon as the baby is born, elevation of the foot of the crib to allow drainage and then if secondary infection takes place the use of antibiotics is all that one can do. Secondary infection does take place as a rule. These babies may live for weeks but they are sorry sights and if the amount of fluid aspirated has been large, relatively few survive. Cyanosis, difficult breathing, the tendency to emphysema and the passage of frothy material from the nose and mouth are frequent high. Just a word about the aspiration of food. It occurs far too often. The baby should be watched carefully after it is fed—it should be turned on its side or on its abdomen. Somebody should be in attendance in the nursery, so that these babies can be watched. Avoid overfeeding. We find the condition most often in premature infants and infants that are debilitated and those with pyloric stenosis who before operation have not had their

stomach properly emptied. If precautions are used we can minimize vomiting although we may not always entirely obviate the condition.

Just a word about kerosene pneumonia; we see a number of cases here. The child mistakes the oil for water, takes a drink of it, chokes, and aspirates it into the lungs. The oil that is aspirated and not the oil that enters the stomach does the harm. I wonder whether or not it is advisable to go to any great degree of trouble to traumatize the baby by washing its stomach out after the accident has happened. We do as a rule. I believe if we do anything about that it is best to give an emetic rather than to use a stomach tube, because if you attempt to wash the stomach you may get aspiration around the tube and a higher degree of involvement of the lung tissue. There is usually suppression of breathing at first, then drowsiness, then fever and then finally the occurrence of broncho-pneumonic manifestations.

Lipoid pneumonia though not common, is something we must keep in mind especially in premature babies, debilitated babies, those babies who are being forced to take cod liver oil when they rebel against it and those who are given oily nose drops. Those are the most common types. Once it starts there is very little that can be done to stop it. Mortality is rather high and the clinical picture is rather distinct. The baby has a distressing cough, does not grow, and thrive, and his X-ray picture is rather conclusive. There is a large amount of consolidation starting from the central portions of hilar portions of each lung and extending peripherally.

Eosinophilic pneumonia may be mistaken for miliary tuberculosis. The X-ray picture looks very much like miliary tuberculosis. We find it in children, however, who have allergic manifestations and the two cases I have seen have been in asthmatic children. The blood picture is interesting because there is a very high eosinophilic count. The disease is not particularly dangerous; it will last a few days to several weeks and then it clears up. The treatment is simply that for any other allergic state.

SUMMARY

Many differences exist between the symptoms of pneumonia in adults and in children. The wise physician will watch particularly for the masking of usual chest signs by gastro-enteric disturbances. The many types of pneumonia encountered in children require care and caution in diagnosis and treatment.

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TREATMENT OF COMPLICATIONS OF PNEUMONIA: MEDICAL ASPECT*

E. E. Wilkinson

Since the widespread use of sulfonamides and antibiotics, the complications of pneumonia are becoming much less frequent.

(1) *Otitis media* was, and probably still is, the most frequent complication of pneumonia. The incidence is generally placed at about 10 per cent but is probably decreasing considerably. The use of sulfonamides or penicillin constitutes prophylaxis and also treatment for the otitis, and these drugs are sufficient in most instances. Occasionally it may be necessary to do a myringotomy. If the tympanium is frankly bulging, this procedure is indicated.

(2) *Septicemia* may be considered a complication or a part of the disease. The treatment needs no special comment here.

(3) *Meningitis* was formerly the most dreaded complication of pneumonia because it carried a mortality rate of nearly 100 per cent (in the pneumococcus type). The route of invasion may be hematogenous if there is a bacteremia, but it is probably more often otitic. Since the advent of newer therapy, its frequency is much less. Again we won't attempt to discuss the management of meningitis.

(4) *Peritonitis* is a rare complication at the present time. The treatment for this is the same as for the pneumonia.

(5) *Pericarditis* is rare and largely restricted to infancy; it usually occurs as a direct extension from the infected pleura. Successful outcome may require surgical drainage.

(6) *Osteomyelitis*, *endocarditis* and *arthritis* may occur very rarely in cases with bacteremia.

(7) *Abdominal distention* or tympanitis is a disturbing complication although its frequency has been reduced by the use of sulfanomides. When it occurs and is persistent, it is usually a reflection of paralytic ileus. Prophylaxis consists of

*From the Department of Pediatrics, The University of Texas Medical Branch, Galveston. Presented at the Pediatric Post-Graduate Conference, Galveston, April 2, 1947.

the early treatment of pneumonia with appropriate drugs, administration of oxygen before extreme cyanosis is present, and the avoidance of constipation. Prostigmine, which is probably the most effective therapeutic agent, should be administered for moderate degrees of distention and especially when it is not relieved by an enema. Doses of 0.5 to 1.0 cc. of a 1 to 4000 solution may be employed for infants of one to two years of age, and the dose may be repeated in two or three hours if the distention is not relieved. Enemas, with a rectal tube left in place, should be employed in addition.

(8) Pulmonary *abscess* is a very rare complication of pneumonia in children. It is more often due to other causes such as aspiration. Multiple small abscesses may occur in staphylococcal pneumonia and in certain aspiration pneumonias.

(9) *Gastro-intestinal complications* apparently were formerly more common than at present. Treatment is carried out along the usual lines of parenteral therapy.

(10) Focal cerebral symptoms occasionally occur in patients with pneumonia; the exact causes of these manifestations are often not clear. Hemorrhage or cerebral sinus thrombosis may be the explanation of some of them. Others may pass as "toxic encephalopathy." Usually there is little that can be done in the way of specific therapy.

(11) Disturbances of myocardial function (in addition to endocarditis and pericarditis) may occur rarely. Heart block or other types of dysfunction have been reported.

(12) *Atelectasis as scattered* small areas is probably present in nearly all pneumonias as a result of blocking of bronchi of various sizes by secretion. A whole lobe or several lobes occasionally may be involved and persist as a massive atelectasis after the pneumonia has run its course. If not relieved spontaneously or by bronchoscopic aspiration, bronchiectasis will develop in the atelectatic portions. No attempt will be made to discuss the treatment of bronchiectasis.

(13) Emphysematous blebs are occasionally seen following pneumonia but no treatment is usually indicated since these tend to disappear spontaneously.

Empyema

Empyema is still the most important complication of pneumonia in spite of the fact that its incidence has been greatly reduced. Formerly it occurred in five to ten per cent of pneumonia patients.

Prior to the widespread use of sulfonamides in the treatment of pneumonia, the pneumococcus was the most frequent causative agent. Next in order of frequency were the hemolytic streptococcus, mixed infections, the staphylococcus and rarely other organisms, influenzal, colon and typhoid bacilli. In Holt and McIntosh's textbook, eleventh edition, published in 1940, 180 cases of empyema observed at Babies Hospital, mostly in patients under three years of age, are mentioned as having the distribution as follows: Pneumococcus, 115 cases; hemolytic streptococcus, 26; staphylococcus, 14; Hemophilus influenzae 1; B. tuberculosis, 1; mixed infections, 23. In children of older age group, more than one-half had empyema due to Type I pneumococcus, while the incidence of hemolytic streptococcus was comparatively low. Riley reported a study of an eleven-year period from 1932 to 1942 and found that in terms of percentage the staphylococcus was the causative agent in 7.3 per cent of all cases from 1932 through 1937 and in 20.4 per cent from 1938 through 1942. Despite the gain in relative frequency, the incidence of this type remained about constant, indicating that sulfonamides have apparently little effect on it.

On the treatment of empyema, in general, sulfonamides or penicillin or preferably both should be employed in full doses. Even before the use of these substances, it was possible to treat some patients satisfactorily with repeated aspirations but, according to most writers, the case fatality rate was higher and the morbidity longer than with surgical drainage. McEnery and Brennemann reported complete cure in 91 per cent of their patients by this method (aspiration alone), results in young infants being particularly gratifying. While others have obtained somewhat less successful results, it is now agreed by many workers that aspiration is the method

of choice in the early stages. McEnery and Brennemann indicated their conclusions as follows: "We would once more emphasize as fully as we know how that the purpose of this paper is not to advocate aspiration as a sole, routine measure in all empyemas of children. We are interested rather in presenting evidence that a large number of empyemas can be cured by aspiration alone; that it is the method of choice in infancy; that empyema is not an emergency and that large amounts of pus can be absorbed; that fibrin masses do not seem as serious an obstacle as is commonly assumed; that a complicating pneumothorax is not an alarming symptom and that when it is a part of a rupture through a bronchus it has often seemed rather to help than to hinder a return to normal; that the evidence is very questionable that pneumococcus empyemas alone are favorable to treatment by aspiration, and that there should be no one routine treatment for empyema in children regardless of the one important factor, the age of the child."

The more recent articles in the literature deal with the treatment of empyema by aspiration with intrapleural use of penicillin. Practically all the recent reports in the pediatric literature deal with staphylococcal empyema and we should like to refer specifically to this type.

Staphylococcal pneumonia is especially common in infants or very young children and consequently staphylococcal empyema is seen for the most part at this early age. Many writers emphasize that the empyema is likely to be a pyoneumothorax, or a tendency for air as well as pus to collect in the pleural cavity. In staphylococcal pneumonia abscesses are frequent and the empyema results from the rupture of an abscess through the pleura.

In determining the outcome in staphylococcal empyema, the most important factor was, before the days of penicillin, the age. Todd and Swan in 1943 reported a mortality of 66.7 per cent from birth to 4 months of age; from 4 months to 12 years the mortality was 4.8 per cent. The mortality for the disease as a whole was about 25 to 35 per cent before the use of intrapleural penicillin.

Davis, Hyman and Ruhstaller report seven patients with staphylococcal pneumonia and empyema who were treated by both intrapleural and intramuscular injections of penicillin. Sulfonamide was also given by mouth. Their mortality rate was 14 per cent, one infant dying 36 hours after admission to the hospital. All patients except one (age 11 years) were infants or very young children. These investigators state that "15,000 to 25,000 units of penicillin should be given intramuscularly every three hours, even to infants, and that larger doses are probably unnecessary. A thoracentesis should be done each day, as much fluid removed as possible, and from 30,000 to 50,000 units of penicillin should be instilled. For older children as much as 50,000 to 75,000 units should be given intrapleurally each day." The dilution usually recommended is 500 units per cc. of normal saline. High levels can be maintained in the pleural fluid by giving penicillin once daily into the pleural space and every three hours intramuscularly. "Cultures of the pleural fluid rapidly become sterile although smears continue to show gram-positive cocci for a varying length of time. One should make daily smears and continue the administration of both intrapleural and intramuscular penicillin for at least one to two weeks after organisms can no longer be found by smear."

Sulfonamide therapy should be instituted as soon as possible and blood levels of 12 to 15 mg. per 100 cubic centimeters should be maintained. Frequent small blood transfusions during the acute stages are beneficial as most infants have a moderately severe anemia with the infection. Additional supportive therapy includes maintenance of adequate intake of calories, fluids and vitamins, especially members of the B complex. Oxygen should be administered when necessary. Davis and co-workers advocate surgical procedure when indicated as for example in those cases in which loculation occurs and there are isolated pockets of pus. As a matter of fact one of their severe patients did require additional trocar drainage with irrigation for a short time.

In conclusion, it would seem that no definite rules can be laid down for the treatment of the individual patient with

empyema. There is enough available evidence, we believe, to advocate the use of aspiration with intrapleural penicillin in the majority of patients that are seen early. Intramuscular penicillin and sulfonamide by mouth should also be used. If response is not satisfactory surgical drainage should be instituted. It can not be emphasized too much that the general pediatric care (fluids, blood transfusions, etc.) is extremely important in the management of these children.

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PLASTIC SURGERY IN CHILDREN*

T. G. Blocker, Jr.

Plastic surgery problems which confront the pediatrician are, in general, related to congenital deformities, acute trauma, and burns. Among the first group harelip with or without associated cleft palate is perhaps the commonest defect. It is indeed a source of great mental distress to the parent both from the cosmetic standpoint and because of the additional hazards in feeding and nursing care. The pediatrician should take upon himself the responsibility for enlightening the family as to the benefits of early surgery on the deformed infant and acquaint the indigent patient with services offered by the State Crippled Children's Funds at one of the various centers for Plastic and Reconstructive Surgery.

Congenital Deformities

It is the universal opinion at the present time that newborn infants with single or double harelip should be operated upon as soon as the general condition permits—usually as soon as weight gain is definitely established, from 2 weeks on. Early repair of the lip aids in molding of a protruding premaxilla and obviates the necessity of fracturing the alveolar process, a routine procedure twenty years ago, which results in dishface deformity and often destruction of the tooth-buds. The feeding problem is greatly simplified, following surgery, especially where there is no coexisting cleft palate. Another argument for early operation is that the small infant is less of an anesthesia problem than the older child. And finally, and perhaps most important, early repair of the lip restores family morale and prevents the development of personality disorders in the child as the result of the stigma of his deformity.

Any surgical treatment of the palate must be delayed at least until 18 months or 2 years of age. Doctor Dorrance,

*Presented by the Professor of Plastic and Maxillo-Facial Surgery at the Pediatric Post-Graduate Conference, The University of Texas Medical Branch, March 31, 1947.

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FIGURE 1

(A) Single incomplete harelip.
(B) Immediately following repair. Note stainless steel wire through the nose over bolsters in each labio-nasal fold to take tension off the suture line.
(C) Final result, six days post-operative.

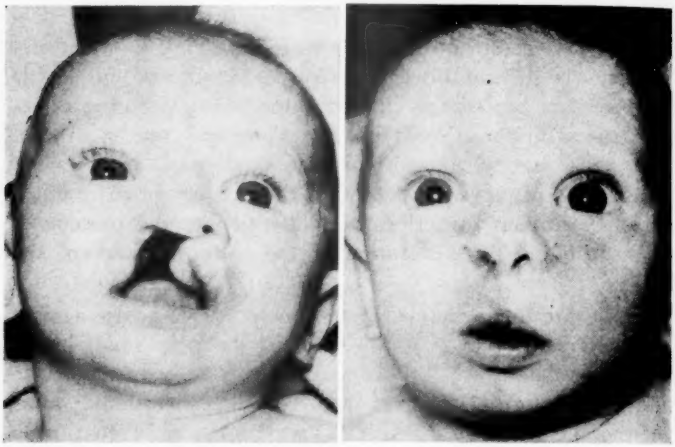
the originator of the "push-back" operation, advocates that no attempt be made to suture the palate until the child is four or six. The more tissue available, the better results will be obtained both as regards speech and swallowing. With a very short palate, two or even more operations will be required to pull the tissues back far enough to prevent the disagreeable nasal twang and often almost unintelligible speech associated with many of the older methods of treatment.

At times we have found it advisable to repair a double harelip in two stages in order that sufficient relaxation of the tissues may be accomplished to give closure without tension. It has been our practice to employ a modification of the Blair-Mirault technique. We feel that successful results depend upon wide undermining of surrounding tissues; accurate approximation of corresponding points to give symmetry, and a smooth vermilion border, careful attention to the contour of the nostril and the restoration of the baby "pucker" of the lips.

As a tip to the pediatricians we would like to advise against the universal practice of "burping" in the very small infant with cleft palate and following operative procedures on the lips, until normal reflexes are completely restored after anesthesia. In such cases it is extremely likely that milk regurgitated with air be drawn into the palatal defect and aspirated into the lungs with disastrous results. Feeding should be accomplished either with a spoon or dropper, which permit much less air to be swallowed than with bottle-and-nipple. In any event, my advice is to let the infant have colic rather than risk asphyxia or aspiration pneumonia.

A congenital deformity which has received little attention in the literature is a maldevelopment of the lower jaw—so-called micrognathia. If the child's tongue is large or unusually mobile, serious or even fatal respiratory obstruction may result from the dropping back of the dorsum of the tongue to occlude the normal airway. Without doubt this type of death occurs frequently in cases of apparently healthy children who are found dead in bed; they are often called "thymus" deaths, but autopsy may reveal no enlargment of the thymus nor

indeed any other pathology to which sudden exitus can be attributed. Following any operation upon infants with micrognathia a suture should be left in the tongue until the patient is completely awake, and a nurse should be at hand at all times. In one instance we have found it a like-saving procedure in a case of "tongue-swallowing" to suture the tongue firmly forward and down to the lower alveolar border.



A B

FIGURE 2

(A) Severe unilateral complete harelip associated with cleft palate.
(B) Eight day post-operative. Palate is to be completed at the age of two to four years.

Other congenital defects which the pediatrician may encounter are the various cysts and sinuses of the neck; the thyroglossal duct cyst in the mid-line, which extends back to the root of the tongue; and the branchiogenetic cysts which are to be found along a line drawn from the ear along the upper half of the anterior border of the sterno-mastoid. A third type is the congenital lymphatic tumor, which may be found most commonly in the neck (cystic hygroma), groin, and axilla. The only satisfactory treatment of these lesions is radical excision.

Occasionally we see dermoid tumors in children and teratomata. Recently we excised a dermoid containing hair and cartilage which had formed from embryological remnants between the two nasal bones.

In the matter of hemangiomas and port-wine stains which occur as birthmarks the present trend of feeling is that these are best treated with some form of irradiation unless they are very small or occur about the eyes where proper shielding cannot be applied. Pigmented and hairy moles which occur on the face or are of such size as to be disfiguring elsewhere may be removed by excision, the resulting defect closed either by rearrangement of the existing tissues or by application of thick-split or full-thicknes graft.

Supernumerary fingers and toes are usually disposed of without difficulty. Congenital syndactylism may be relieved by application of small full-thickness grafts to the web spaces.

Treatment of Acute Injuries

There are certain general principles of management which should be observed in the treatment of acute injuries in children from a plastic standpoint. The first consideration should be, as in other emergency surgery, hemostasis, restoration of normal air-way, treatment of shock and prevention of infection.

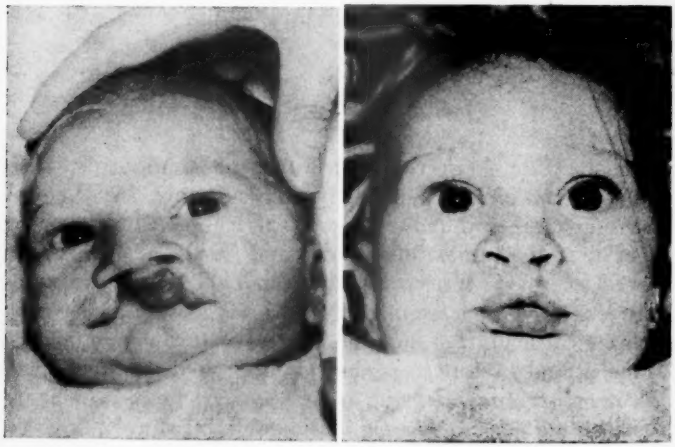
On the face conservative debridement is the rule, with cutting away of known devitalized tissue only. Mechanical cleansing of the wound by copious irrigation with water or saline is of the utmost importance and should be done under general anesthesia if necessary in a small child. The surrounding skin must be carefully cleansed with soap and water. Antiseptics should not come in contact with the raw surface of the wound. White soap may be used; at the present time, however, certain detergents have been developed which are nonirritating and may be of considerable benefit.

The face has abundant circulation and resists infections well unless edema is allowed to occur or a hematoma develops. Of great importance is the avoidance of tension in the suturing of a wound. The surgeon should not hesitate to undermine

the tissues for relaxation in drawing the skin edges together. Closure should always be made in layers to avoid formation of a dead space which might collect blood or serum and foster bacterial growth.

In avulsion wounds a minimum of tissue will be lost if an attempt is not made at primary closure. This is particularly true of through-and-through wounds of the cheek where the mucous membrane may be merely sutured to the skin in order that the tissues may relax and stay relaxed. In some instances, for early healing, immediate split grafts may be employed as a temporary dressing. In others, where considerable edema is present, warm moist compresses of boric solution or saline may be applied until the edema subsides before grafting or secondary closure.

As a final precaution against infection, the patient should be given suitable inoculations against gas-forming organisms and tetanus. For all heavily contaminated cases, chemotherapy should be routinely employed for several days. One must



A B

FIGURE 3

(A) Severe bilateral harelip.
(B) Result.

not forget, however, that thorough mechanical cleansing of the wound is far superior to any chemotherapeutic agent now known or likely to be found in the future. We strongly advise against the use of any agent in the wound itself.

Careful technic in wound closure is essential for good cosmetic results. Tension, as has been mentioned, should be avoided at all costs. Infection may produce irregular, hypertrophied, or depressed scars and secondary loss of tissue. Accurate closure in layers is imperative for minimal scars. The deep layers should be closed shorter than the superficial layers and sutures placed in the skin to give the line of healing a slightly raised position. Fine suture material is preferable, and the sutures should be placed close together to distribute tension over the entire healing line; their early removal prevents permanent "stitch marks."

The choice of suture material varies with the preference of the individual operator. After employing most of the material advocated from time to time in the past we ourselves prefer stainless steel wire for all layers of the skin whenever possible. The deep layers may be closed with one or more removable continuous No. 36 stainless steel wires and the skin with No. 40 interrupted sutures of the same material. Wire has practically no reaction from the tissues but like any other suture must not be placed in too tightly.

Lacerations which fall across normal lines of the face or through-and-through wounds across the lid, lip or ala margins must be staggered to prevent linear contracture and resultant notching. Because of the loose character of the skin in the neck, vertical defects (perpendicular to the lines of Langer) must be closed by the conventional "Z" plasty to prevent contracture of hypertrophy of the scar. Though horizontal linear defects on the forehead and chin give practically imperceptible scars after accurate closure, the cheek offers a considerable different problem. No matter in what direction the defect occurs, meticulous care is necessary for minimum scarring. In some individuals with very loose skin it is wise to stagger a linear laceration to prevent a straight-line contracture with resultant depression. With circular flap lacera-

tions great care must be exerted to prevent collection of blood or serum under the flap portion with resulting mound or biscuit deformity from scar contracture.

The use of pressure dressings is important to prevent edema, to improve the circulation to the part by enhancing the drainage and prevention of stagnation, and, probably the most important of all, for immobilization purposes. Elastic adhesive serves the purpose admirably in some instances but should also be supplemented as a general rule with a larger bulky dressing held in position by an elastic bandage. We feel that pressure should be maintained until healing is complete.

In the case of fractures of the facial bones, it is imperative that a normal airway be maintained. The patient should be transported in the prone position or on his side—never on his back. Whenever there has been severe injury to the floor of the mouth, a tracheotomy set should be kept at hand, although employed only as a last resort. Often a nasopharyngeal airway will suffice.

Accurate approximation of bone fragments should be accomplished as soon as possible after injury but only after preliminary treatment of shock and severe complications. Very extensive wounds of the face in children with marked displacement of bone fragments are usually fatal because of concurrent head injury. With less radical injuries it often happens that fragments fall back into place spontaneously because of their elasticity or may be easily reduced with fractures of the greenstick variety. For jaw fractures immobilization in occlusion must be accomplished. Of course, if there has been considerable loss of bone substance, preparations should be made for subsequent bone grafting, with stabilization of the jaw in the position of function. Maxillary and nasal fractures should be reduced as soon as feasible and maintained until strong fibrous union has occurred.

Old scars fall into two general groups: those in which there is shortening of the skin due to lack of surface cover; and those which result from incisions which are "directionally incorrect" and lacerations across the flexion creases and normal lines of skin tension. In these instances in which there

is actual loss of skin, grafts or flaps must be employed. In many cases, however, contractures may be relieved by simple Z-plasties or rotational flaps. Where there are associated deep lesions such as nerve injuries or loss of bone, flaps of skin and subcutaneous tissue must be supplied for extra cover prior to alleviation of the underlying condition.

In the relief of volar hand contractures, it must be borne in mind that in the state of contracture there has been shortening of the underlying tendons, nerves, and blood vessels as the result of disuse. In the correction of the deformity the hand must be brought out to full extension in approximately the same length of time as was required for development of the contractures. Lengthening of the various structures can be accomplished only by active physical use, and skin must be added to the palm in stages until full extension can be accomplished.

Burns

The menace of burns among small children is ever-present, and there is scarcely a pediatrician who has not had tragic experience in seeing the acute or delayed results of accidents from scalding water, steam, flame, chemicals, or hot stoves and grills. An undiagnosed convulsive disorder may be at fault and should always be suspected when the parent gives a history of the child's fainting and falling into a tub of hot water or against a stove.

Fashion in local treatment of burns has gone through many cycles from the time-honored home remedy of soda and lard through unguentine, foille, and similar preparations, tannic acid, sulfonamide ointments, and petrolatum. "Healing without a scar" is usually attributed by the layman and unfortunately at times by the physician to the use of one patent preparation or another. Healing without scarring occurs only in superficial burns which are not complicated by gross infection. In third degree burns skin cannot be regenerated over the involved area; growth of epithelium from the periphery of the wound does not constitute a satisfactory cover except in the case of very small burns.

In the treatment of severe burns general care takes precedence over local measures; 75% of patients with fatal burns die of shock, the remainder of toxemia and infection. It might be well to review the pathological physiology of burns in this connection. Except in superficial lesions involving the epidermis only, there is immediate injury to the capillary walls which results in exudation of plasma into the area and also damage to cell membranes so that tissue spaces become distended with fluid. Subcutaneous loss of fluid, which goes into the lymphatic system eventually, may even exceed external loss. Rapid pouring out of plasma is accentuated by the dilatation of capillaries and small vessels following initial vasoconstriction. Loss of large amounts of fluid from the active circulation results in hemoconcentration, diminished blood volume, low cardiac output, low blood pressure, and increased peripheral resistance to blood flow. The absorption of toxic products of the necrotic skin or of substances applied locally increases the degree of shock as does excessive handling of the patient. The factors of pain and external temperature are not believed to be as important etiological agents in the development of shock from burns as in other types of injuries. Outpouring of plasma is greatest during the first twelve hours after injury and ceases after 48 hours, at which time the patient begins to reabsorb fluid from the tissue spaces and "transfuse" himself, so to speak. With superficial burns, following reëstablishment of fluid equilibrium and normal tone of vessels, dead cells are gradually removed by lysis and phagocytosis. With deep burns, this process of lysis occurs only at the junction of living and dead cells, and collagen fibers keep the slough attached until this is accomplished.

In addition to the type of burn and the depth of injury, the severity depends upon the amount of body surface area involved. A child with 8% or more of skin loss from burn is certain to develop shock unless radical measures are instituted. Berkow has devised a convenient guide for estimating body surface area. In the adult the head makes up 6%; upper extremities 18%; lower extremities, including the buttocks, 38%; and trunk, including neck and genitalia, 38%. Since

the proportions of children vary greatly, a modified table has been devised, as follows:

Head 6% plus 12-age
Trunk 38% plus half of 12-age
Lower extremities 38% minus 12-age
Upper extremities 18% plus half of 12-age

Thus, in a year-old baby, a burn of the entire head would involve 17% of the entire skin area, approximately the same as if there were complete circular burns of both lower extremities. The specific agent in the treatment of burn shock is plasma. Various methods have been devised for estimating the amount of plasma which will be required by the individual adult patient according to the hematocrit reading, the hemoglobin in grams above normal, the blood volume (a method rarely available), and the amount of body surface area involved. These, in my experience, are never of as great value as clinical judgment based upon general appearance of the patient, evidence of dehydration, pulse, respiration, blood pressure, and temperature readings taken frequently, and amount of urinary output.

Perhaps the simplest method in the small child is to calculate the total fluid requirements per 24 hours on the basis of 70–90 cc. per pound and give 1/4, 1/3 (in severe shock, even more) in the form of plasma. With syringe transfusion 10 cc. per pound may be given initially and repeated as required so that approximately half of the estimated plasma is given in the first 6 hours, ¼ in the second 6 hours, and ½ in the remaining 12. If oral intake is limited, the remaining fluids should be given in the form of intravenous 5% glucose in water and clyses of normal saline or 2½% glucose in saline. With older children it is satisfactory to use continuous drip through any available vein, using the femoral if necessary or even the external jugular.

Hemoconcentration is not a contra-indication to transfusion, and since anemia usually develops about the third day, it has been my practice to initiate at that time, or even before, small transfusions of whole blood every other day in children, until the general condition is satisfactory.

A B

FIGURE 4

(A) Severe deformity face and neck contracture secondary to burns third degree face, neck, and left arm.

(B) Appearance two months following release of neck contracture by split graft.

As to local treatment of acute burns, the first rule is to do nothing until shock has been treated or measures have been taken to prevent its occurrence. The second rule is asepsis. No dressing of extensive burns should be done in the office or the emergency room, and all attendants in the operating room should be properly attired in masks, gowns, and gloves to prevent contamination of the open burn wound. Debridement and cleaning are not necessary unless the wound is very dirty grossly. It should be performed only with cotton pledgets and bland soap. No green soap or chemicals such as benzene, ether, or antiseptics should touch the wound. It is inadvisable to use either sulfonamide ointment or crystals on the surface since there is uncontrolled absorption of these substances into the general circulation at a time when kidney function cannot be predicted. It is better to begin injections of penicillin (and here let me make a plea for the use of penicillin in ¼% procaine solution for children) at once and wait a day or so

before adding sulfonamides. Tannic acid is extremely toxic wherever the skin is moist from secretions, exudate, or ointments. Our procedure and the one most commonly advocated at the present time is to apply nothing over the surface of the burn except a pressure dressing. We find a very satisfactory material for the first layer a single piece of rayon wet with normal saline. It does not adhere to the wound and allows secretions to pass through. Over this a bulky pressure dressing of gauze, mechanics' waste, and finally elastic (Ace) bandage is placed, firmly but not so tightly as to interfere with circulation or produce a tourniquet effect. Unless the dressing is contaminated by secretions from the mouth or by urine or feces, it should be left in place for 10 to 12 days before changing. By the time of the second dressing about the 18th or 21st day second-degree burns unless grossly infected will have healed, and third-degree burns will be ready for first grafting procedures.

Since water-soluble vitamins are lost along with plasma during the initial stages of the burn, attention must be paid to their restoration orally or parenterally. The patient should be placed on a high caloric, high-protein, high-carbohydrate diet, and it should be seen to that the ordered diet is palatable and consumed. We had very favorable results during the war feeding burn patients with marked malnutrition very large doses of protein in the form of edible casein mixed with ice cream and malt drinks.

Occasionally in a patient with very extensive burns the temporary use of hemografts may be life-saving. The skin itself acts as a very satisfactory dressing, reducing the loss of fluid through raw areas and eliminating the absorption of toxic products into the general circulation. It should be considered, I believe, in every case of burn involving more than 30% of the body surface area where the patient shows evidence of marked "chronic" shock and toxemia.

The delayed treatment of burns is unfortunately usually the lot of the plastic surgeon, who sees the patient months after injury when there is marked exuberance of granulations, and complications of infection, anemia, weight loss, and malnu-

trition. Before operation can be performed, the child must be put in optimum condition generally with proper feeding, vitamins, transfusions, and saline baths for local treatment of burned area.

Where contractures and keloids have occurred in old third-degree burns, the plastic problems are the same as in any type of scarring and old deformity. Wherever possible relief of the defect is obtained by excision and rearrangement of existing tissues with rotational flaps and Z-plasties. For extensive lesions resort must be made to grafts and pedicle flaps to produce supple skin covering and restore function and as normal appearance as possible to the injured child.

Summary

Plastic surgery may be significantly helpful to the pediatrician in connection with congenital deformities, acute traumatic conditions, and burns. The indications and scope of reparative effort may be estimated by careful study and conference involving individual cases.

SURGICAL TREATMENT OF POST-PNEUMONIC EMPYEMA IN CHILDREN*

A. W. Harrison

There has been considerable controversy over the effect penicillin therapy has had on the indications for surgical intervention in thoracic empyema, particularly of the post-pneumonic type. Many writers seem to believe that penicillin may prevent or abort early infection, but has in no wise changed the principle of drainage once suppuration is established. Blades reported 13 cases of post-pneumonic empyema treated with both intramuscular and local penicillin. Of these, 11 required drainage in spite of the fact that in 10 cases the fluid had become sterile. Two were classed as penicillin cures and one became chronic. Of course, these were not in children but it seems reasonable to allow some degree of comparison since there were no particularly satisfactory statistics available for children alone.

To further illustrate the comparative effect, 6 cases were reported treated by the intramuscular route alone. Of these, 5 required open drainage. In 2 cases the fluid became sterile and one was considered a penicillin cure. One case became chronic. Of 5 cases receiving only local penicillin, all became sterile; all required drainage. One became chronic.

Numerous other writers report series of 2 to 3 or even 6 to 8 cases treated with penicillin with recovery without drainage. The patient just shown represents such a case. A little consideration, however, will reveal the great variety of factors that determine the outcome. In the first place attention has been repeatedly called to the fact that a certain number, probably in the neighborhood of 25% of post-pneumonic pleural fluids will resolve spontaneously. It is not stated just how many of these would show positive cultures or possess other special characteristics, but it at least indicates a fairly definite tendency to spontaneous resolution, particularly if assisted by a little aspiration.

*From the Department of Surgery, The University of Texas School of Medicine, Galveston. Presented at the Pediatric Post-Graduate Conference, April 2, 1947.

On the other hand, Butler, Perry and Valentine reported sterilization of the pleural fluid in 17 cases in 2 to 5 days, but with recurrence of 28% in 16 to 18 days, or on an average of about one week after penicillin was discontinued. The recurrences responded readily to surgical drainage.

Thus, we have this evidence. A certain number of postpneumonic pleural exudates would clear spontaneously. Simple aspiration greatly assists this tendency. With the addition of penicillin both intramuscularly and intrapleurally many more cases may be prevented or cured. There are, however, just as definitely certain cases that do not respond favorably so that it becomes the responsibility of anyone who treats these complications to be able to differentiate between the favorable and unfavorable responses.

It is difficult to make generalizations and it is hardly sufficient to say that each case must be judged on its own merits. But we must try to establish some working principles. Obviously, the cases at the extremes cause little question. The extensive loculated or clotted empyema will certainly not respond to aspiration. The smaller well-pocketed pneumonococcus empyema will respond to open drainage most readily. The small early infected accumulation will clear on aspiration-penicillin.

The great middle bulk of cases, however, require more thought. These are the more extensive accumulations, the thinner exudates, those caused by staphylococcus and streptococcus and often associated with more or less underlying lung pathology. Here we can say in general that a thorough trial with penicillin should first be given. The critical point then becomes the recognition of the failure or impending failure of this regimen. In the case shown today aspiration soon became impossible even though considerable thickening and loculation were still present on X-ray. On careful observation this progressed to clearing before the infection could counterattack. But until this was fairly well along, the outcome remained in considerable doubt.

It would not require much stretch of the imagination to see a flare-up back at the stage of increased pleural thicken-

ing after aspiration was no longer effective. It might very well have flared up after penicillin was discontinued, or: by no means an uncommon occurrence. The common explanation for this, by the way, is the presence of a loculation untouched by needle and penicillin. An even greater danger is the persistent, crippling, chronic productive pleuritis.

Unfortunately the cause of these two occurrences is too often the fault of the physician or surgeon. The price of a penicillin or non-surgical triumph may come a bit high and not in terms of dollars and cents. To subject a child to so many needle punctures over a period of one, two or three months for a questionable result when simple drainage would have relieved the toxicity in a few days and effected a cure in a few weeks, does not seem fair to the patient.

As to when to give up aspiration for surgical drainage, no definite time limit can be set, but one should have a pretty good idea of how the response is going within two weeks. One thing is particularly important. The fact that the fluid has become sterile should not influence ones judgment. Frequent X-ray check in both front and lateral views is the best indicator. Decisive action usually pays off well both in time saved and wear and tear on the patient.

It is especially important that the pediatrician or surgeon keep an eye to chronicity, a very real and very constant danger. In most instances it is the most important danger for these cases. Once surgery is decided upon the entire effort of the surgeon is bent to this very end, the prevention of chronicity. This consists, as in most other surgical operations, in the removal of the obstructions to the natural processes of healing. The well loculated cases usually do all right with open drainage, and probably most of the unsuccessful penicillin trials would fall in this group. The earlier more extensive empyemas should have closed drainage. By closed drainage is meant the newer tendency to a more complete surgical attack. At operation a larger incision is made and the pleural space is cleared under direct vision. This may involve the stripping of considerable clotted exudate from the pleural surfaces. Then the wound is sutured tight about a larger drainage tube.

When closed drainage is established, the matter of irrigation, tidal drainage or the like is not particularly important. The idea should be to clear the pleural space as rapidly as possible and expand the lung as completely as possible by whatever means as seem most applicable. A little half-strength Dakin's solution is good for the first function but should not be kept up very long. It seems to have a decided slowing effect on the obliteration of the pleural space. Tidal irrigation seems to place too much emphasis on the irrigation and too little on reëxpansion of the lung. There is the risk of incomplete evacuation.

In cases where the empyema cavity comes clean but its walls appear resistant, a little extra negative pressure has proven quite effective. This is some additional trouble to the surgeon but he may be surprised at its effectiveness.

In the ordinary course of events the closed drainage can be converted to open drainage after a few days by simply cutting off the tube near the skin and fixing it in place. From there on it is largely a matter of physical therapy. Of course, the cavity must be kept clean and draining well but the important thing is mobilization of the thoracic cage and the imprisoned lung. If the child is old enough to coöperate, deep breathing exercises are especially good and can be aided by encouragement or even bribery. The younger children can be encouraged to become active. In one case here we tried CO_2 hyperventilation in lieu of breathing exercises. This may or may not be a good idea.

Finally the drainage tube should not be removed on the 5th day or the 14th day or the 31st day. It should be removed when and only when the cavity is obliterated. It is as simple as that. Yet too often other criteria are used. The little hole in the chest wall I assure you will close most obligingly at any time.

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THE PHYSICIAN'S ROLE IN BEHAVIOR PROBLEMS IN CHILDREN*

J. L. Treadway

It would be dull and trite to attempt to cover the entire field of child psychiatry with a synopsis of each disorder; therefore, this discussion will be informative to only a limited extent. The primary thing is to try to make clear a certain viewpoint and what should be our correct attitude.

A fanatic is a person whose views on a subject are 100% for or against. Each thing is either all important or of no importance. I am not a fanatic on child psychiatry. I do not feel that it is the most important subject in pediatrics. None the less, when we consider this matter in its proper perspective, child psychiatry has a very definite place of its own in the field of pediatrics.

Child psychiatry is something like a preacher who gives many long sermons on hell-fire and brimstone and warns the congregation to "get religion"—but doesn't tell them how to go about this laudable achievement. It also reminds me of some directives issued by the higher commanders in the Army, stating in effect, "Get morale—get a better spirit," but containing no directions for accomplishing these commands so that the officers who dealt directly with troops were often very much puzzled as to just what they were supposed to do.

Similarly the fathers of pediatrics have decreed that we be competent to guide children to physical and mental maturity. But, as far as I know, we have no organized program specifying what a pediatrician should know about child psychiatry. A survey by the Commonwealth Fund in 1932 of professors of pediatrics would indicate that perhaps many of those who talk about "guiding children to good mental health" are paying merely lip service to a subject in which they are grounded poorly themselves.

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*From the Department of Pediatrics of The University of Texas School of Medicine, Galveston. Presented at the Pediatric Post-Graduate Conference, April 4, 1947.

At any rate, in the above mentioned survey on a question as to the jurisdiction of the pediatrician versus the psychiatrist in the field of behavior problems in children, six men assigned the therapeutic task to the psychiatrist, twenty-two to the pediatrician, and twenty-four considered it a matter for joint efforts. These figures would indicate that the professors of pediatrics were not certain just where they stood themselves. In the same survey, these men felt that an average of 30% of all pediatric problems are behavior problems.

In the 1930 White House Conference on Child Health, the experts selected in the field of child psychiatry couldn't even agree on the most basic issues; and in 1931, Dr. Joseph Brennemann wrote an article entitled, "The Menace of Child Psychiatry," pointedly reflecting the widespread confusion of opinions, claims, theories and assertions.

All of the above comments are more understandable when we consider that the specialty of pediatrics itself has barely outgrown its infancy and the pediatrician is still struggling in an attempt to digest all the tremendous material and new advances relating to his specialty.

To the average pediatrician, psychiatry is a confusing subject couched in an unfamiliar vocabulary of its own and best left out of every day practice. It is also one in which he feels inadequate—as well he might if a study of the time allotted to this subject in various medical schools were any indication—our own being no exception. Pediatricians defend themselves against child psychiatry in a more or less standard manner as represented by the following all-inclusive statements. "I don't think it's so important and see very few cases." "It takes too much time." "It is all just common sense."

Let us discuss these statements individually, starting with the number one or "ostrich approach." There is an old German adage which goes, "Was man weisz, man sicht." Ten years ago, we never saw erythroblastosis or fibrocystic disease of the pancreas. As has been indicated above, fifty-two professors of pediatrics have estimated 30% of all pediatric problems are behavior problems. The pediatrician who doesn't

see child psychiatry problems is really shutting his eyes tightly what with our present day divorce rate approaching 33-1/3% and our adult psychiatry rate jumping by leaps and bounds plus a highly mobile, shifting population. Our perfection of contraceptives and resultant small families where mothers can really concentrate on the whys and wherefores of every little action of junior and our complex civilization which forces a child to conform from infancy to adulthood to everything from feeding and bowel movements to religion and politics tend to increase psychiatric disorders.

Now for the second objection—"Child psychiatry takes too much time." We will come back to this item presently but just in passing, we might note that as one acquires facility in recognizing behavior problems and understanding them, the time required is reduced. Furthermore, the time element may be dependent on the scope of the problem and whether it is apparent or obscure, just as in physical disease. We might recall how long it takes a junior student to do a physical examination, sift the history and findings, and come up with a diagnosis in a case which may be apparent to an experienced physician at a glance.

These statements are not intended to shirk the issue. Behavior problems require a certain amount of time. Establishing an unshakable diagnosis in a case of brucellosis also requires a certain amount of time. In fact one of the requisites for practicing good medicine is the allotment of a certain amount of this same precious time to each case. There are probably far more mistakes in medicine due to carelessness and hurried diagnosis than are due to ignorance.

The third objection to child behavior problems is that "it's all just common sense." I am all for simplification but not oversimplification. We should not underestimate our subject. The patient can suffer equally as much from common sense without specialized knowledge as he can from specialized knowledge without common sense. We would be quick to remind a psychiatrist on this issue if we suspected him of wandering into the realm of treating contagious diseases in our pediatric patients, but we do not hesitate at all to dismiss

child psychiatry completely by stating it is just common sense and thereby giving ourselves complete freedom to decide behavior problems on our own terms.

I'll grant that the final advice of a psychiatrist may be just common sense. However, it is an opinion which is arrived at after considering all the factors involved in a case and coming to a definite diagnosis. A comparable example might be two practitioners treating a case of upper respiratory infection with chronic cough in an adult. One man asks a few questions and places his stethoscope on the patient's chest a few moments and prescribes sulfa. The other takes a careful history, does a thorough physical examination, perhaps takes X-rays, and runs through a differential diagnosis from simple upper respiratory infection to tuberculosis, carcinoma of the lung and aortic aneurysm. Finally, he too prescribes sulfa. The point is obvious. It is the manner in which the diagnosis is arrived at that is of importance to the welfare of the patient and not the fact that both men prescribed the same drug.

One thing more, a psychiatrist starts with enormous advantages which the rest of us, if we choose to compete with him, need not grant him. He realizes that mental upsets ranging from tantrums to actual disabling disorders are serious matters on which it is *worth spending time.* He settles down to solve the problems of conduct as energetically and as persistently as do the rest of us to solve intricate problems of physical diagnosis. It is obvious we cannot all become psychiatrists nor can we refer all behavior problems to psychiatrists since there are only 250 full time child psychiatrists in the United States. Because most of us give advice, we should at least try to ascertain by working a little more assiduously towards understanding children and their behavior problems, that such advice is reasonably good. No one else has the weight of authority behind his words as the family physician, and parents are more likely to follow his advice than any other. But when he gets into the realm of psychiatry, unless he has training, he steps off his scientific pedestal and is relying on common sense just like Mr. Anthony and Dorothy Dix.

At this point, I would like to cite several illustrative examples to clarify the meaning of child psychiatry from a pediatric viewpoint, because I feel that every pediatrician while damning it and shrinking away has been practicing it to a considerable extent either for better or for worse.

There are many of our ultra-moderns who are much preoccupied with sex and the proper techniques conducive to connubial bliss. We hear a lot about emotional frustration in marriage. At the same time, we may condone a regime for raising a baby by leaving him on his own as much as possible without interfering in the old fashioned way. A four months-old baby with soiled pants, who is crying and lying in bed awaiting a bottle from its mother, receives a good deal of physical and emotional satisfaction by being picked up, having its clothes changed, cuddled and cooed over and given a bottle. Baby has utilized and enjoyed the following: 1. Normal satisfaction or relief of full bladder and bowel; 2. Physical comfort of clean clothes; 3. Practiced his visual accomplishments; 4. Listened to a pleasant and familiar voice which he has come to associate with the relief of his difficulties and satisfaction of his needs; 5. Tasted and smelled food and relieved the painful demands of his gastrointestinal tract, and 6. Probably exercised a bit and practiced his limited vocalizations. The effect of omitting all these physical and emotional satisfactions is obvious when we consider orphans and institutionalized children who are dull and apathetic, slow in vocalizing, and emotionally blunted.

In the early months of infancy, the movement of the bowels is a simple reflex initiated by the mass movement within the colon. Nothing inhibits this unless the infant experiences painful movements from hard stools. When this reflex movement occurs regularly, the observant mother can often catch it in an appropriate vessel and as time goes by, she may substitute suppositories and enemas to establish a more convenient time or to relieve "constipation" when the infant's bowels do not move with clock-like regularity. This ignores nature's physiological reflex mechanism, and the fact that true training implies that the brain takes over its control. When baby

reaches the beginning of the second year, he has had nature's reflex mechanism "trained" out of him and mother places him on the potty and demands a bowel movement. This is often the beginning of a persistent struggle against toilet training and mother forcing the baby to sit on the toilet for long periods to produce the desired results. Since baby's handiest weapon at this stage is negativism and his sense of proprietorship over his movements is likely to be offended, there may be definite changes in this small child's personality in the ensuing long battle against training. This type of training often results in the child soiling his pants, after being removed from the toilet seat. Also a child trained in this way may have "accidents." He feels guilty and insecure because he senses mother's disapproval and is in an emotional turmoil because of it. Such a child may reach the age of five years with a compulsion to feel his pants often because he is obsessed with the fear of soiling himself. Such childhood experiences certainly do not breed a feeling of confidence into the future personality.

What I have tried to bring out, in a perhaps inept sort of way, is that even in such an everyday thing as bowel training, there is the element of child psychiatry and knowledge of the growing child's normal development is on a sound neurological and psychiological basis as has been amply demonstrated by the pioneer work of Tilney, McGraw, Aldrich, Gessel and many others. A pediatrician who understands the child's physical and neuromuscular development and the emotional problems which the child faces at the different age levels is in a position to practice pediatrics which is good child psychiatry.

This may be the proper place to interject a few comments as to just what our approach may be as regards prevention of future mental disease by correct guidance in childhood. We do not know the etiology and early signs of psychoses and are not in a position at present to designate who are the potentially spychotic children. We are, therefore, certainly not in a position to undertake a large scale preventive psychiatry program for children as far as the major psychoses are con-

cerned. Whatever other mental conditions are preventable by correct guidance during childhood is a moot question. If we treat conditions of unhappiness as they exist, we are doing everything possible to provide the optimum conditions for satisfactory mental and physical growth.

Time precludes a full discussion of a case which I present at this time. Briefly, it is a seven-year-old boy brought in by his mother because of persistent enuresis. The pediatrician did a complete physical—noting a slight phimosis and advised fluid restriction and a salt sandwich in the evening. After urinalysis and several follow-ups with persistence of enuresis, circumscision was performed with no improvement. Periodic hydrostatic dilations were done subsequently with cessation of enuresis. The parents and the physician were both highly pleased.

The actual facts in the case were that the father was a psychoneurotic discharged from the army and the mother a former school teacher. Both had a severe guilt reaction because of the death of a former sibling of pertussis who had not been immunized. Because of this there was an extraordinary amount of parental overprotection and failure of this child to take normal responsibilities and to form companions with the neighborhood kids who regarded him as a sissy. There were numerous quarrels between the parents in the presence of the child. This boy's I.Q. was 90, but his mother had taught him at home before starting school and had managed to push him ahead one grade. This little boy masturbated, was very restless at night, had temper tantrums, and was afraid of the dark and would not go to sleep in a darkened room.

Even from this inadequate history, it is easy to see the doctor didn't "cure" the patient. He merely stopped a complaint which was part of a general personality maladjustment, poor home care, home environment and unsatisfactory school placement. This boy will certainly develop more than enough behavior problems to replace the complaint of enuresis. The doctor forgot that there was a living child and a personality attached to the bladder upon which he was concentrating.

The complaint itself is relatively unimportant as compared to the underlying reasons for the manifestation presented, and such complaints are rarely unaccompanied by other just as serious personality maladjustment.

If this doctor had gone into this patient's intellectual capacity, environmental situation and emotional make-up besides just doting on his physical status, he probably would have saved the patient much more future unhappiness and suffering than the boy will ever suffer from any organic causes.

A few words concerning psychotherapy. Everyone who will handle children should understand the basic principles and dynamics involved. A good reference is "Psychotherapy with Children" written by Dr. Frederick H. Allen, Philadelphia Child Guidance Clinic and Assistant Professor of Psychiatry, University of Pennsylvania Medical School. Not that we are all going to become specialists in psychotherapy, but an understanding of psychotherapeutic principles and dynamics will enable us to avoid many pitfalls in dealing with children and parents. This is true even if we never handle any behavior problems.

1. With any behavior problem, the mother (or parents) and child should be interviewed separately. Otherwise, we have mama answering for junior when she feels he is inaccurate or not saying the things he should. The child is also in the same boat and obviously isn't going to say he likes papa and thinks mama is an old witch with mama sitting and glaring at him. Each parent should be interviewed separately for similar reasons.

2. We must know how the child himself feels about coming to the doctor and the problem for which he is brought. He must be allowed to speak freely about himself, and we must know what and how he thinks. We must correlate all I.Q. tests, physical examinations, complaints, environmental situations and objective observations of behavior with the subjective views of the patient himself.

3. With children this is often a difficult job. More often than not, the child distrusts interrogation by a strange adult, fearing what he says will be relayed to his parents resulting

in his criticism or even punishment. His natural fear of doctors and inability to speak abstractly make it time consuming and extremely difficult to get reliable statements from him concerning his true feelings. He knows what everyone expects him to say. He likes school; mama and papa treat him fine; he never lies, steals, plays hooky or mistreats the family cat. In short, he's just the person he feels his parents, teachers and the doctor expect him to be.

4. It is obvious from the beginning that a child brought in with a behavior problem is afraid, angry or both. We should recognize this. If we follow our natural inclinations and seek to relieve the child's anxiety by reassurance and admonitions, such as "I'm your friend now—I won't hurt you—just tell me all about so and so," this only serves to increase the child's anxiety. It is much more practical to tell him you know he is afraid or angry, as the case may be, but that you have faith in his ability to meet the situation.

5. Arranged play situations for smaller children. It is the little boy doll who has tantrums, wets the bed and hates mother. Thus, the child's underlying feelings and attitudes are projected into the doll so that he can express his thoughts and feelings with comparative freedom and no longer feels the restraint of what he is expected to say.

6. One cannot let parents put the weight on one's shoulders for making dogmatic decisions. They must decide on military school or whatever is needed. One cannot let the child do this either. The parents and the child must help themselves.

Anyone who considers the voluminous literature of psychiatry must be amazed at the variety as well as the intricacy of our theory and practice. Who is right? Freud, Meyer, Watson, Adler or dozens of others? Which is the white-haired one? This variety is not so challenging or imposing as the fact that each of these theories works beautifully. What are we to gather from this fact? It can mean only one thing, that it is the fact of contact rather than the content of that contact that is the important matter. There can be no other answer to the fact of relative success for such numerous and diverse approaches to these complicated problems. I believe this is

also the solution to the not infrequent happening that a psychitarist achieves considerable success in helping a patient to adapt himself and yet cannot lay his finger on the precise feature of therapy that brought it about. I also wonder how often analysts may be mistaken in ascribing cure to certain childhood experiences after the patient has reviewed his whole life history during the process of psychotherapy.

SUMMARY

Child psychiatry has definite place in pediatrics when viewed in its proper perspective. Pediatricians should be able to handle the majority of behavior problems. We have reviewed the infant of a few months of age and at the nursery training state to point out that knowledge of his normal neuromuscular and emotional development is everyday pediatrics and based on a fundamentally sound and scientific basis. We feel that this knowledge constitutes an important part of child psychiatry.

THE IDENTIFICATION OF AN ORNITHOSIS VIRUS FROM THE WILLET*

MORRIS POLLARD, C. D. CAPLOVITZ AND C. D. SWAUSCH

Ornithosis has been reported in a great variety of non-psittacine birds, including pigeons (Pinkerton and Swank), ducks (Meyer) and chickens (Meyer and Eddie). The fulmar petrel, too, has been shown to be a carrier of this infection and was presumably responsible for an outbreak of ornithotic pneumonia in the Faroe Islands (Haagen and Mauer). A severe outbreak of pneumonitis has been reported in Louisiana and has been identified as ornithosis (Olson and Larson). The source of infection in this latter outbreak has not yet been determined.

A recent survey of the incidence of ornithosis-like infection among sea-shore birds indicated that over 40% of the willets *(Catotrophorus semipalmatis semipalmatis G)*, laughing gulls *(Larus atricilla)*, and skimmers *(Rynchops nigra L.)* which were examined showed serological evidence of this disease. In view of the high percentages among the willets and laughing gulls, attempts were made to isolate the agent from these two species.

ISOLATION TECHNIQUE

Since the liver, spleen and kidneys of ornithosis infected birds has been reported as the most reliable source of infection, pools of the latter two organs were examined for evidence of the ornithosis agent. Spleen and kidney emulsions from birds, in groups of two, were inoculated intraperitoneally and intracerebrally into six mice. If no reaction ensued after twenty-one days, the spleen and brain tissues of these mice were passaged blindly through two series of mice by the intracerebral route. Using this procedure, eight laughing gulls were examined and were found to be negative. Eight willets were similarly examined and a virulent agent was isolated

*From the Department of Preventive Medicine and Public Health, The University of Texas, Medical Branch, Galveston. Received for publication May 10, 1947.

from one kidney and spleen pool. This agent which has been designated as "W"-ornithosis strain was lethal to mice within 2–3 days after intracerebral inoculation. It has thus far been passaged through eight series of mice.[1] Giemsa stained impression smears of infected mouse brain tissues contained microscopically visible intra-cytoplasmic inclusion bodies which are similar to those described for psittacosis (Leventhal, Coles and Lillie). (Figure 1.)

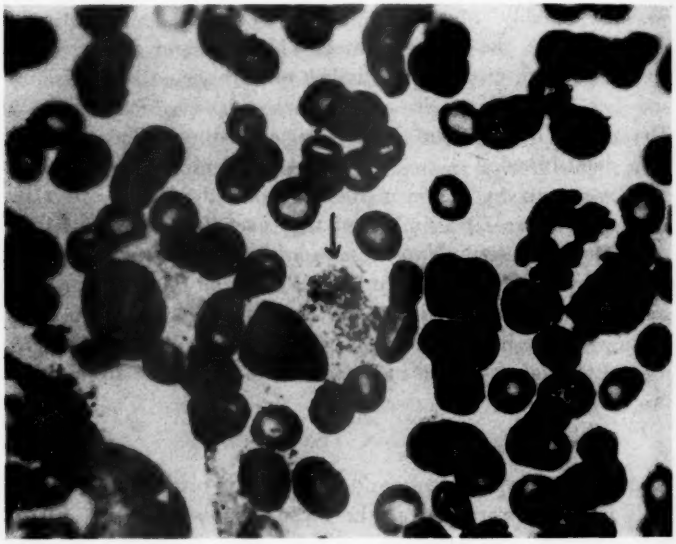

FIGURE 1

Inclusion bodies of "W"-ornithosis agent. Arrow points to a group of inclusion bodies in the cytoplasm of a mono-nuclear cell. Giemsa stain. X1200.

SEROLOGICAL IDENTIFICATION

The "W" strain was adapted to the developing chick embryo. From the chorio-allantoic fluid of infected embryos (inoculated at 7 days and dead 3–4 days later), a complement fixing

[1]This agent killed one rabbit on the 4th day after an intracerebral inoculation of 0.2 cc. mouse brain emulsion.

antigen was prepared by sedimenting the heat killed agent (56° C./30 minutes) at 18,000 rpm/20 minutes and resuspending the sediment to 1/10 its original volume.

Normal rabbits were immunized with mouse brains, infected with P-4 strain of psittacosis, and the "W" strain from the willet. Simultaneous complement fixation tests demonstrated a serological relationship between the known psittacosis strain and the unknown agent from the willet (Figure 2). The "W" antigent fixed complement with the "W" anti-

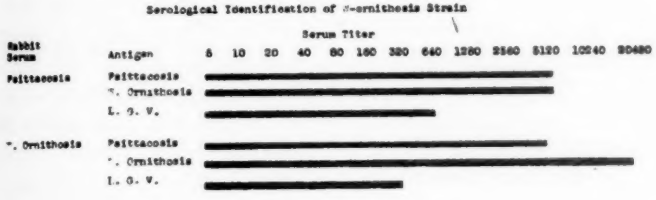

FIGURE 2

Chart indicating the serological relationship of the "W" ornithosis agent to standard strains of psittacosis and lymphogranuloma venereum agents.

serum, psittacosis antiserum, and also with human lymphogranuloma venereum serum. The psittacosis (P-4) antigen also fixed complement with the three serums noted above.

SUMMARY

On the basis of the morphological and serological evidence presented herein, a pathogenic agent which was isolated from the willet species *(Catatrophorus semipalmatis semipalmatis G)* has been identified as one of the lymphogranuloma venereum-ornithosis groups.

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EFFECT OF ANTIRETICULAR CYTOTOXIC SERUM UPON THE RESPIRATION OF BONE MARROW SUSPENSIONS*

ARTHUR L. COHEN, MILDRED RUNJAVAC, AND REUBEN STRAUS

Antireticular cytotoxic serum (ACS) has been used experimentally and clinically by Soviet workers for the alteration of functions connected with the reticulo-endothelial system. According to the theory first propounded by Metchnikoff and expanded and tested by Bogomolets very small quantities of antisera prepared against reticulo-endothelial elements should stimulate the functions of the reticulo-endothelial system while larger doses should be suppressing. In the United States, Pomerat and Anigstein have demonstrated suppression of growth in tissue cultures, Straus et al., have shown both suppression and stimulation of bone repair in rabbits and Miale has demonstrated leucocytosis and monocytosis with stimulating doses of ACS in dogs.

Whether or not ACS has direct local effect on the tissues was not known, therefore experiments were undertaken to observe the effects of different concentrations of the specific ACS on guinea-pig and on rabbit marrow.

EXPERIMENTAL

Guinea-pig ACS was prepared by injecting saline extracts of ground guinea pig marrow and spleen into rabbits, and rabbit ACS was similarly prepared by the injection of saline extracts of rabbit marrow and spleen suspensions into goats. The preparation and titration of ACS are fully described elsewhere (Straus et al.).

Marrow was scraped from the tibia, femur, humerus of three young adult guinea pigs and pooled in 7 ml. Tyrode's solution with the observance of aseptic precautions. Marrow was obtained similarly from one young adult rabbit for the

*From the Institute for Medical Research of the Cedars of Lebanon Hospital, Los Angeles, California. Received for Publication May 18, 1947.

second experiment and the total volume of Tyrode's solution brought to 10 ml.

In both cases the marrow was forced through a hypodermic syringe several times to break up large clumps. Microscopic examination of the suspensions showed no significant cell damage due to this procedure.

Since the experiments were designed to run for many hours, penicillin (Squibb) was added to prevent bacterial growth. Penicillin has been used routinely in similar experiments by Borsook, Cohen, and Dubnoff (unpublished) without influencing the experimental procedure.

The tested suspensions consisted of:

normal rabbit serum (NRS)	7 ml.
marrow suspension in Tyrode's solution	7 ml.
penicillin q.s.	500 units/ml.
dextrose	15 mgm.
phenol red, 0.1%	0.7 ml.

For both experiments Warburg vessels equipped with center-wells and two side-arms were used. Two ml. marrow suspension was placed in each vessel, and 0.1 ml. of serum in each side-arm. The dilutions employed were so arranged that first a high dilution of ACS was added to the contents, and then a lower one by emptying of the second side-arm (See Table I). The contents of side-arms *A* were added 65 minutes after 0 time, and of *B*, 150 minutes after 0 time. A small amplitude of shaking was used to minimize the clumping of cells high on the side of the vessel, and the bath was maintained at 36.9° C.

TABLE I

	Dilutions of ACS		
Vessel pairs	1	2	3
Side-arm A (0.1 ml)	10^0	10^2	10^4
Side-arm B (0.1 ml)	10^0	10^2	10^3

In the experiment on the respiration of guinea pig marrow it was decided to obtain the carbon dioxide production as well as the oxygen consumption, therefore the vessels were arranged

in three pairs with one member of each pair containing potassium hydroxide in the center well.

As rabbit serum made up half the suspension medium, no control side-arms with normal rabbit serum were employed. For the experiment with guinea pig marrow, readings were stopped after four hours, the vessels and manometers set aside at room temperature (approximately 20° C.) until the eighteenth hour when they were again placed in the bath to run an additional 3.75 hours until conclusion. The rabbit marrow was suspended in a homologous serum; therefore, for the second experiment, corresponding dilutions of normal goat serum (NGS) were used with the ACS prepared from goats. For rabbit marrow the following arrangement with potassium hydroxide in all center wells was employed (Table II).

TABLE II

Dilutions of:	ACS			NGS		
Vessel number	1	2	3	4	5	6
Side-arm A (0.1 ml)	10^{0}	10^{-6}	10^{-5}	10^{0}	10^{-6}	10^{-5}
Side-arm B (0.1 ml)	10^{0}	10^{-2}	10^{-3}	10^{0}	10^{-2}	10^{-3}

The contents of side-arms *A* of vessels 2, 3, 5, and 6 were added 45 minutes after zero time, and the contents of both side-arms of vessels 1 and 4 were added at the same time, thus adding to the suspension 10% of its own volume of undiluted ACS and NGS respectively. The contents of side-arms *B* of the remaining vessels were added 200 minutes after 0 time.

Center wells were recharged with potassium hydroxide and an addition of 0.1 ml. of 10% dextrose was made to each flask eighteen hours after initiation of the experiment for the guinea pig marrow and 25.5 hours after initiation of the rabbit marrow experiment.

The experiment on the respiration of rabbit marrow was interrupted after approximately 7 hours and the vessels left at room temperature for 18.5 hours when measurements were again resumed until the conclusion of the experiment after an additional 18.7 hours.

Results and Conclusions

Inspection of the results given in figure 1 for guinea pig marrow and in figure 2 for rabbit marrow shows no effect of ACS on the respiration of marrow throughout the course of the experiment. Within the limits of accuracy imposed by the Warburg apparatus, the type of material and the several interruptions of the experiment, each curve retains its original slope from initiation until the conclusion of the experiment.

The CO_2 productio nfor guinea pig marrow approached and, after 18 hours, achieved parallelism with the O_2 consumption indicating that the R/Q remained approximately unity for all concentrations of ACS throughout the experiment.

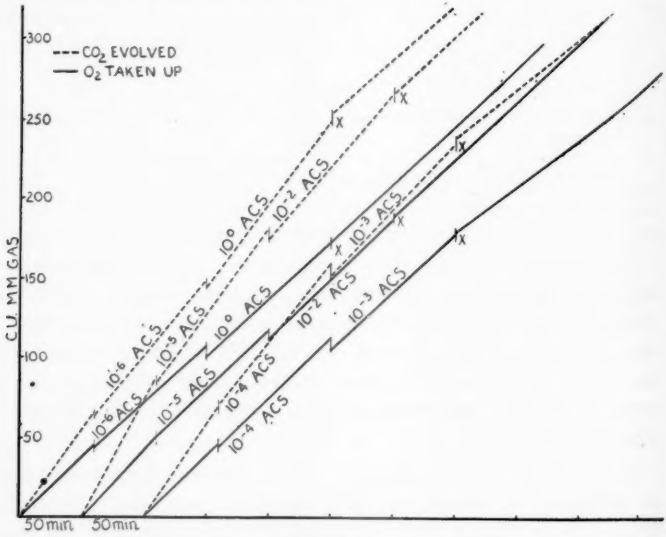

FIGURE 1

Oxygen consumption and carbon dioxide production of guinea pig bone marrow with different concentrations of anti-guinea pig ACS produced in rabbits. At points marked X, vessels removed to room temperature (approximately 20° C.) for 18 hours before resumption. For further explanation, see text.

The rabbit marrow was allowed to respire until the second charge of dextrose was used up approximately 44 hours after

initiation, and it may be seen that equal quantities of dextrose were completely metabolized at approximately the same time (group III curves; figure 2).

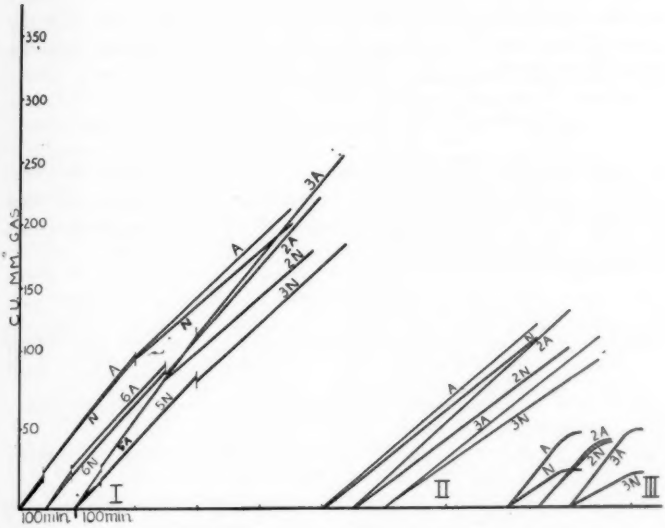

FIGURE 2

Oxygen consumption of rabbit marrow with different concentrations of anti-rabbit ACS produced in goats (A) and normal goat serum (N). Equivalent concentrations of A and N are paired. A, N; 2A, 2N; 3A, 3N; 5A, 5N; 6A, 6N; refer respectively to reciprocal logarithms of concentrations of A and N in the side-arms, i.e., undiluted, 10^{-2} dilution, 10^{-3} dilution, etc. Group I curves: initiation of experiment and continuation through 450 minutes. Group II curves: continuation of same curves after incubation at room temperature for 18.5 hours and addition of dextrose (see text). Group III curves: continuation of same curves as in group II with lapse of 11 hours. Note that all curves approach parallelism with the axis at approximately the same time, indicating no effect of ACS. For further explanation, see text.

The length of time over which ACS was acting is perhaps open to question. Lyophilized ACS, having a titer of 1:320, reconstituted to original volume was used for the guinea pig experiment, while freshly prepared ACS titer 1:160, was used for the rabbit experiment. In the latter experiment tubes of the same ACS were incubated in the same bath with the vessels and were found to have lost approximately half the titer after one-hour hour at 36.9° C.

Summary

Antireticular cytotoxic serum was found to have no effect on the respiration of marrow suspensions of guinea pigs and rabbits during an incubation time of 22 hours and 44 hours respectively in dilutions from 10^{-6} to 10^{0}.

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Straus, R., Horwitz, M., Levinthal, D., Cohen, A., and Runjavac, M.: Studies on Antireticular Cytotoxic Serum. III. Effect of ACS on the healing of experimentally produced fractures in rabbits. J. Immun., *54:* 163, 1946.

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CALLING ATTENTION TO:

Items of Possible Interest to Our Friends
JUNE, 1947

1. ARMY MEDICAL LIBRARY: Note brief historical survey by R. Hood (*Science* 105: 422, Apr. 25/47). Urgent support needed for essential fire-proof building near Library of Congress. Support also needed to arrange details of coöperation with AMA for full author subject monthly comprehensive index to world medical literature, cumulative annually. Contributions solicited by Consultants: Write Col. Harold Jones, Library of Congress, Washington, D.C.

2. FEDERATION PROCEEDINGS: Program and Abstracts (*Fed. Proc.* 6: 1–433/47) of Chicago session from synthetic penicillin to neutralization of bacteriophage offer extended picture of patient picking of isolated bits of data. Much on renal and cardiac function, hypertension, enzymes, nucleic acids, autonomic drugs, nerve conduction, antibiotics, chemotherapy, drug toxicity, and vitamins. Univ. of Rochester group reports on pharmacology of uranium. Session on biometrics, biophysics, performance, shock, repair, teaching and research methods. Not much on radiactive tracers. Over 1900 authors!

3. PHYSIOLOGICAL: G. E. Cartwright reviews (665 ref.) dietary factors in erythropoiesis (*Blood* 2: 111, 140, 257/47). E. C. Mason suggests CO_2 loss is a factor in mobilization of body fluids (*Ann. Int. Med.* 26: 561/47). D. Gabor discusses acoustical quanta and the theory of hearing (*Nature* 159: 591, May 3/47). C. L. Schneider shows active principle of placental toxin to be thromboplastin (causing toxemia of pregnancy?), inactivated by heparin (*Amer. J. Physiol.* 149: 123/47). G. Schloss suggests that renal tubules help produce renin (*Helv. Med. Acta* 14: 22/47). S. C. Way further reports on reticulum and lattice fivers (*Arch. Dermat. Syph.* 55: 478/47). A. Lawson and C. Rimington observe antithyroid action of erothioneine, a normal blood constituent (*Lancet* 1: 586, May 3/47). S. W. Wortis, G. Bateson, W. E. Galt, M. Herman, A. C. Kinsey, and W. C. Young discuss physiological and psychological factors in sex behavior *Ann. N.Y. Acad. Sci.* 57: 603–664/47). N. Emmelin describes broncho-constricting action of bile acids (*Acta Physiol. Scand.* 13: 20/47). A. Arvanitaki and N. Chalazonitis discuss relation of activity potentials to respiratory calaysts (*Arch. Internat. Physiol.* 54: 406–457/47). R. M. Kark and large Co. of Canadian and U.S. colleagues disprove myth of necessary deterioration of white men in the tropics (*Medicine* 26: 1/47). E. N. Harvey and J. H. McMillen study shock waves in tissues from impact of high velocity missiles (*J. Exp. Med.* 85: 321/47). J. R. Klein and N. S. Olsen find induced convulsions go with decreased brain glycogen, glucose, and adenosine triphosphate, and increased lactate and inorganic phosphorus (*J. Biol. Chem.* 167: 747/47). W. Trager isolates

a fat soluble material from plasma having the biological properties of biotin (*Proc. Soc. Exp. Biol. Med.* 64: 129/47).

4. PHARMACOLOGICAL: I. Chavez and Co. describe diagnostic value of direct intracardiac angiocardiography with diodrast (50 cc. 70% sol. in 1 second) (*Amer. Heart J.* 33: 560/47). D. P. Cuthbertson and Jac Knox confirm G. Alles (*Amer. J. Physiol.* 136: 392/47) and P. K. Knoefel (*Fed. Proc.* 2: 83/47) that benzedrine and methedrine reduce fatigue (*J. Physiol.* 106: 42/47). M. M. Gertler and D. Karp find atabrine helpful in auricular fibrillation (*Proc. Soc. Exp. Biol. Med.* 64: 213/47). W. H. Hall and W. W. Spink note sensitivity of *Brucella* to streptomycin and growth of resistance during treatment (*Ibid.* p. 403). J. V. Scudi and W. Antopol note pharmacological features of bacitracin (*Ibid.* p. 503).

5. AND SO ON: P. A. Owren describes parahemophilia,—a hemorrhagic condition due to absence of unknown clotting factor (*Lancet* 1: 446, Apr. 5/47). F. A. Denz reviews hunger edema (*Quart. J. Med.* 16: 1/47). K. R. Eriksen notes even sensitive bacteria may produce penicillinase (*Acta Path. Microbiol. Scand.* 23: 489/47). J. M. Mackintosh pleasantly suggests applying child guidance principles to old age (*Lancet* 1: 659, May 17/47). J. N. Walton discusses physical factors in continuous intravenous infusions (*Ibid.* p. 662). N. R. Pai describes nature and treatment of writer's cramp (*J. Ment. Sci.* 93: 68/47). T. Braatov discusses experimental neurasthenia and intellectual overstrain (*J. Nerv. Ment. Dis.* 105: 477/47). C. P. Rhoads describes cancer as a systemic disease (*Amer. Rev. Sov. Med.* 4: 333/47 and C. M. Pomerat discusses ACS, p. 340). In pleasant note of farewell, H. E. Sigerist discusses nationalism and internationalism in medicine (*Bull. Hist. Med.* 21: 5/47). A. J. Coale analyses the problem of reducing vulnerability to atomic bombs (Princeton Univ. Press, '47, 190 pp., $2). N. R. Stoll describes this wormy world (*J. Parasitol.* 33: 1/47).

JULY, 1947

1. NEW BOOKS: Richly merited is the testimonial volume to Willstatter's great pupil, Arthur Stoll (Stoll Festschrift, B. Schwabe, Basle, '47, 688 pp., Sw. fr. 30). Excellent is C. Singer and C. Rabin's *Prelude to Modern Science: Being a discussion of the History, Sources and Circumstances of the Tabulae Anatomicae Sex of Vesalius* (Wellcome Hist. Med. Mus., Cambridge Press, 144 pp., '47, with facsimile (why not all in folio?), 50s). M. Spiegel-Adolf and G. C. Henny offer *X-Ray Diggraction Studies in Biology and Medicine* (Grune and Stratton, N.Y., '47, 222 pp., $5.50). J. Adriani discusses *Techniques and Procedures of Anesthesia* (C. C. Thomas, Springfield, Ill., '47, 408 pp., $6). F. J. Hodges and Co. write stimulating *Radiology* for Medical Students (Yearbook, Chicago, '47, 424 pp., $5). W. J. Dann and G. H. Satterfield edit Vol. XII Biological Symposia, Estimation of the Vitamins (Ronald Press, N.Y., '47, 531 pp., $6.50).

2. Blood: G. R. Minot succinctly discusses diagnosis and treatment of macrocytic anemias (Trans. Stud. Coll. Phys. Phila. 15: 1/47). C. J. Watson and Co. report purpura following estrogen therapy (J. Lab. Clin. Med. 32: 607/47). W. Wilhelmij reports average size of erythrocytes increases with emaciation (*Acta Med. Scand.* 128: 274/47). S. P. Lucia and M. L. Hunt describe significance of deviations from average myeloid maturation curve from sternal bone marrow smears (*Am. J. Med. Sci.* 213: 686/47). H. R. Gutmann and Co. note that nicotinamice aids in reduction of methemoglobin by methylene blue and that reduced phosopyridine nucleotide causes rapid reduction of methb. (*J. Biol. Chem.* 169: 145/47). A. Fischer (Carlsberg Fd., Copenhagen) neatly reviews participation of blood proteins in metabolism of tissue cells (*Biol. Rev. Cambridge Philo. Soc.* 22: 178/47). J. Gonzales Q. and C. A. Angere suggest adrenal cortical hormone essential for O_2 uptake of red cells (*Am. J. Physiol.* 149: 502/47).

3. Cancer: Important survey of chemical carcinogenesis appears (*Brit. Med. Bull.* 4: 309–426, 1947) including A. Haddow on mechanism of carincogenesis, H. G. Crabtree on anticarcinogenesis, E. Boyland on metabolism of carcinogenic compounds. H. Burrows on estrogens and neoplasia, S. A. Henry on occupational cancer, and A. Haddow on chemotherapy of cancer. T. Hanschka and Co. find T. Cruzi inhibits mouse tumors nonspecifically and without promoting survival (*J. Nat. Cancer Inst.* 7: 189/47).

4. Pharmacological: K. W. Donald well describes oxygen poisoning in man, emphasizing CNS involvement (*Brit. Med. J.* 1: 712. May 24/47). E. K. Marshall well reviews principles, methods and results of chemotherapy (*Med.* 26: 155/47). W. H. Fishman proposes that B glucuronidase is essential to estrogen action (*J. Biol. Chem.* 169: 7/47). S. C. Sulkin and C. Zarafonetis continue studies on inhibiting effects of ether on neurotropic viruses (*J. Exp. Med.* 85: 559, '47). P. H. Nexmand and O. Sylvest show that while the dimethyl aminoethyl benzylanilines ("antargan") or benzhydryl ethers ("benadryl") do not prevent histamine urticaria, they do reduce symptoms (*Acta Dermato. Ven.* 27: 231/47). T. T. Puck analyses mechanism of aerial disinfection by glycols (*J. Exp. Med.* 85: 729/47). R. Patiala notes antibiotic action of allyl isosulfocyanates on various dermatophytes (*Ann. Parasitol.* 21: 338/47). T. F. Dougherty and A. White offer evidence that rate of release of gamma globulin from lymphocytes is controlled by pituitary adrenal cortical secretion (*J. Lab. Clin. Med.* 32: 584/47). B. H. Robbins and J. S. Lundy review curare and relatives (*Anesth.* 8: 252/47). N. A. David and A. C. Kirchhof find that hydroxyalkylamide contributes to action of lysergic acid and specifically to uteroactivity (*Schweiz Med. Woch.* 77: 13, Jan. 11/47). D. Bovet and Co. report curare action of quinoyloxy pentane di-iodo ethylate (*Comp. Rend. Acad. Sci.* 223: 597/46).

5. NOTABLE: For fine objective reporting on sociological and mental hygiene problems, see Rebecca West's *Opera at Greenville* in the June 14 *New Yorker*. H. R. R. Grieve reflects on freedom (*Med. J. Austral.* 1: 545, May 3/47). Pleasant historical turn highlighted inaugural of Thomas Addison (1793–1860) Lectures at Guy's Hospital by E. C. Dodds (*Lancet* 1: 699, May 24/47). K. Lengenhager offers evidence that physical and mental disturbance from long hyperventilation are due to alkalotic hypocapnia rather than to tissue hypoxia (*Helv. Med. Acta* 14: 137/47). C. A. Mills and Co. further show increased thiamine requirement in tropics (*Amer. J. Physiol.* 149: 376/47). H. Hoagland well discusses enzyme kinetics and dynamics of behavior (*J. Comp. Physiol. Psychol.* 40: 107/47). E. D. Adrian philosophizes wisely in his Hughlings Jackson Lecture (*Brain* 70: 1/47) on principles of nervous activity. A. R. Moritz and F. C. Henriques continue work on thermal injury (*Arch. Path.* 43: 466, 489/47). H. F. Adler and F. S. Grodins analyse abdominal symptoms at altitude (Proj. 493, Rep. 1, AAF Sch. Avia. Med., Randolph Field, Texas, 1947).

AUGUST, 1947

1. BOOKOLOGY: Wise would be all doctors and medical students to study carefully Part I *(Principia Diagnostica)*, including "Logic and Diagnosis" and "The Ōrganon of Diagnosis," of Logan Clendening's *Methods of Diagnosis* (ed. E. H. Hashinger, Mosby, St. Louis, '47, 883 pp., $10). Delightfully historical and stimulatingly informative is A. T. Rasmussen's *Some Trends in Neuro-Anatomy* (Brown, Dubuque, Ia., '47, 100 pp., $2). Important is A. Szent-Gyorgyi's *Chemistry of Muscular Contraction* (Academic Press, N.Y., '47, 157 pp., $4.50). Association of Vitamin Chemists offers *Methods of Vitamin Assay* (Interscience, N.Y., '47, 208 pp., $3.50). It will be interesting to observe how unbiased and skeptical H. Sigerist may be in his *Medicine and Health in the Soviet Union* (Am.-Sov. Med. Soc., N.Y., '47, 416 pp., $5). S. H. Bartley and E. Chute distinguish between subjective phenomena of fatigue and impairment phenomena of tissue change in their *Fatigue and Impairment in Man* (McGraw-Hill, N.Y., '47, 420 pp., $5). In spite of English objection Excerpta Medica is issuing 15 abstract journals covering world medical literature: annual subscription is $145: American agents are Williams & Wilkins, Baltimore: initial issues look well: entirely in English. E. T. D. Fletcher offers *Medical Disorders of the Locomotor System Including the Rheumatic Diseases* (Livingstone, Edinburgh, '47, 636 pp., 45s). J. H. Wredden gives a useful discussion of *The Microscope: Its Theory and Applications*, with an historical introduction by W. E. W. Baker (Churchill, London, '47, 410 pp., 21s). On the medico-social front appears *A Medical Survey of the Bituminous-Coal Industry: Report of the Coal Mines Administration* (Dept. Interior, Washington, '47, 268 pp. plus 67 pp. photos). G. S. Lewis (author of The Screwtape Letters and The Problem of Pain) offers an interesting anthology of notes of George

MacDonald (1824–1904) (Macmillan, N.Y., '47, 128 pp., $1.50). E. L. Potter discusses *Rh: Its Relation to Congenital Hemolytic Disease and to Intragroup Transfusion Reactions* (Yearbook Publ., Chicago, '47, 344 pp., $6).

2. PHYSIOLOGY: E. R. Trethewie shows tendency of achlorhydrics to become allergic (*Med. J. Austral.* 1: 633, May 24/47). H. Hartridge reviews advances in physiology of vision (*Brit. Med. J.* 1: 637, Apr. 27/46; 1: 913, June 28/47). W. D. M. Paton and A. Sand describes optimum intrapulmonary pressure in underwater respiration (*J. Physiol.* 106: 119/47). F. Davies and Co. find ventricles, containing more nucleotide, have more potential energy than auricles (*Ibid.* p. 154). W. Schweizer demonstrates 1-tyrosine poisoning (counteracted by thiouracil) in rats (*Ibid.* p. 167). L. Calma and S. Wright report that K ions specifically stimulate certain afferent fibers in posterior nerve roots (*Ibid.* p. 211). F. C. Bartlett ably discusses measurement of human skill (*Brit. Med. J.* 1: 823, 877, June 14, 21/47).

3. PHARMACOLOGY: B. Shapiro explains phloridzin glucosuria on basis of depression of dehydrogenase systems involved in phosphorylation (*Biochem. J.* 41: 151/47). G. T. Stocking describes use of "Synhexyl," one of R. Adams tetrahydrocannabinols, as a euphoriant for depressive mental states (*Brit. Med. J.* 1: 918, June 28/47). A brief history of the chemical story of penicillin is offered by the editorial board of the coming monograph on penicillin synthesis (*Science* 105: 653, June 27/47). G. Ungar reports release of proteolytic enzyme in anaphylactic and peptone shock in vitro (*Lancet* 1: 708, May 24/47). M. Wachstein shows d-serine to be nephrotoxic, with protection by other amino acids preventing its tubular reabsorption (*Arch. Path.* 43: 503, 515/47).

4. OTHEROLOGY: H. Koch offers exhaustive study of allergy in chronic otitis (Suppl. LXII, *Acta Oto-Laryng.*, Lund, '47, 211 pp.). G. Holler and F. Scholl discuss the problem of the relation of nutrition to goiter (*Wien Med. Wochnschr.* 59: 321, May 23/47). O. Hechter and E. L. Scully continue studies on spreading factors, including hyaluronidase (*J. Exper. Med.* 86: 19/47). L. Halberstaedter and J. Leibowitz find x-rays produce hemolysis and fixation of erythrocyts (*Biochem. J.* 41: 235/47). S. E. Brolin and T. Thunberg observe high citric acid content of thyroid, decreasing in women after menopause (*Acta Physiol. Scand.* 13: 211/47). E. G. Robertson considers some physical aspects of encephalography (*Brain* 70: 59/47). J. Y. Neel surveys clinical detection of genetic carriers of inherited disease (*Medicine* 26: 115, '47). I. H. Perry makes an interesting case record of Vincent van Gogh's illness (*Bull. Hist. Med.* 21: 146/47). I. Galdston salutes the New York Academy of Medicine on its centennial (*J. Hist. Med.* 2: 147/47). N. Howard-Jones critically studies the origin of hypodermic medication (*Ibid.* p. 201). Our J. B. Cross reports cytological study of Toxoplasma with reference to effect on host cell (*J. Infect. Dis.* 80: 278/47).